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NEW TYPES OF TOBACCO.

At the meeting of the Committee of Agricultural Experiments at Peradeniya on May 13th and of the Ceylon Agricultural Society at Kandy on May 25th, samples of tobacco grown and prepared at the Government Trial Ground, Jaffna, by MR. SCHERFFIUS, the Government Tobacco Expert, were exhibited for the first time. They comprise types of all the five general classes of tobacco, namely—cigarette, pipe, chewing, cigar wrapper and cigar filler, so far successfully grown in one small plantation ; a most exceptional result to have been achieved due, MR. SCHERFFIUS considers, to the particularly suitable soil and climate of the Peninsula. Special interest attaches to them, as leaf of like quality has probably never before been grown in Ceylon. They demonstrate that leaf suitable for the European market can probably be grown in Ceylon and if so they may prove the beginning of a new industry in the island. MR. SCHERFFIUS, who comes from Lexington, Kentucky, the centre of the White Burley district where a hundred million pounds of it are produced annually, has expressed the opinion that the White Burley leaf just produced in Jaffna is equal in texture to and better in colour than the average produced in its original home in America. This is all the more significant when it is remembered that it is only in a very limited area in the States that White Burley can be successfully grown. This pipe and chewing type is very easily cured, requiring no artificial heat or fermentation, but it will not stand heavy manuring. We must

await reports from England before being able to speak as to flavour. We can perhaps grow tobacco through a range of 4,000 feet elevation, so we could probably produce several of the market grades enumerated above.

The tobacco industry of Nyasaland as at present established for exporting tobacco to England dates from 1906, in which year 199,020 lb. valued at £3,317, the product of 421 acres, was exported. In the year 1912-13, 2,262,545 lb. were exported, the product of 7,411 acres, the area being increased the following year to 10,496 acres. The crop is mainly flue-cured Virginian bright leaf ; the greater part being produced in the district of Blantyre which has an elevation of about 3,000 feet and a rainfall approximately of between 35 and 45 inches. The experience of Nyasaland is encouraging and it is worth while to examine how the industry has been so rapidly built up.

Tobacco growing is a highly specialised industry requiring for its success experienced men. Disappointment and loss will certainly be encountered if amateur efforts are solely relied upon. But every planter cannot employ his own expert ; some form of combination will therefore be necessary if the industry is to prosper in Ceylon. In Nyasaland the industry owes its success very largely to the Imperial Tobacco Company, Limited, whose specialists are available for giving advice to planters as to curing and bulking ; and who purchase leaf from them for cash, packing it in their own factory. As the industry grew experienced planters began to pack their own crops and export them to London themselves, but the Company still purchase half the crop of the Protectorate. Such a Company should have land of its own to grow sufficient tobacco to keep its staff and factory going should neighbouring planters fail to bring in sufficient leaf ; conditions which correspond to some extent to those prevailing in the tea industry of Ceylon, wherein large estates purchase green leaf from small neighbours.

A tendency was observed in Nyasaland for planters to put larger areas under crop than could be carefully cured, and it was considered that 100 to 150 acres was as much as one planter could undertake unless he happened to be a man of ripe

GOVERNMENT TOBACCO TRIAL GROUND, JAFFNA

Cigar wrapper leaf. Note plants not topped, and selected seed heads enclosed in paper bags.

Photos by H. F. Macmillan.

Air-curing shed on right; flue-curing shed in course of construction on left.

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experience. Nothing is gained but only loss incurred if more is attempted than can be properly handled and low grade tobacco, on which little profit can be made, produced in consequence.

In South Africa, where a tobacco industry is also being established, warehouses for fermenting, classifying and baling are in some cases controlled by Co-operative Credit Societies who can obtain Loans from the Land Bank. In this country there is no Land Bank, but the Ceylon Government has made provision for advancing loans to Co-operative Credit Societies registered under the Ordinance. In one tobacco warehouse in South Africa conducted on the co-operative system the gain in value of tobacco handled in 1912 was sufficient to pay for all the expenses of the business and leave a profit of £6,000 for the Society. A very important part of the warehouse business is selling. Buyers treating with a large warehouse properly conducted can rely upon deliveries being according to contract and the salesman being in touch with market requirements can advise planters as to the grades most in demand.

R. N. L.

VALUES OF FEEDING STUFFS.

Soya Bean Cake.—Nutritive value, 1 : 1. 1. Cost per food unit, 1*s.* 4½*d.*

The soya bean and its products are highly esteemed in the East for both man and beast. Owing to their comparatively recent introduction to this country, their practical value is not fully known. The cake is rich in protein, but possesses distinctly laxative, not to say scouring, properties. It should, therefore, be fed with great discretion, and it is suggested that it should never exceed one-fourth of the concentrated ration. At present prices it is a very cheap foodstuff, and should form an efficient substitute for part of the linseed cake in a ration. It can be mixed without danger with maize gluten feeds and a combination of bean and rice meal. It is usually fed in combination with common cotton cake. Further information is given in Special Leaflet No. 8.

Coconut Cake.—Nutritive ratio, 1 : 3. 8. Price per food unit, 1*s.* 5½*d.* This cake is of comparatively recent introduction into this country. Per food unit it is a comparatively cheap food, and is esteemed on the Continent for dairy feeding, and may be fed in quantities up to 3 to 4 lb. a day, being damped before use. At present prices it might be used as a substitute for more expensive foods in the concentrated rations for dairy cows, and should certainly be given further trial for feeding for meat production. Further information is given in Special Leaflets Nos. 8 and 20.

Palm-nut Kernel Cake.—Nutritive ratio, 1 : 4. Price per food unit, 1*s.* 7*d.*

This food is dearer per unit on some markets than coconut cake. It is very similar to coconut cake, and may be substituted for it.—BOARD OF AGRICULTURE JOURNAL.

COCONUTS.

YIELD OF COCONUTS IN THE PHILIPPINES.

O. W. BARRETT.

In reply to a question by MR. WERNHAM as to the yield per acre of coconuts and the cost of planting, MR. BARRETT said : In my opinion, fifty good selected trees per acre is the optimum, as we call it. If you put on forty trees per acre, you may get a larger tree, and a few more nuts off each ; but you must then remember that you will be ten trees short per acre ; and if you get 100 or 150 nuts per tree that is a pretty good production. It you put 75 palms per acre, it is certainly too much. So although some are planting the trees only 30 or 33 feet apart, I think that, considering everything, 50 feet is the proper distance in ordinary more or less sloping, but not quite level, soil. Coconuts should not be planted on quite level soil. It is impossible to say what the steady yield per acre will be until you know the soil thoroughly, and how the trees are behaving. Probably 100 nuts per tree, or about 5,000 per year per acre, is not going very far out of the way for a plantation which is neither best nor worst, but is moderately clean. We get 250 to 300 nuts per tree in parts where the soil is exceptionally rich and well watered. But the general average in one part is below 30, probably not more than 20 nuts per tree. But even that is not an estimate for all places, because I have shown you photographs of over-planted areas, where half the trees will be without any nuts at all, and have been in that condition, perhaps, for years. Even on the Penal Constitution Farm there are trees nine and ten years old which have not shown any sign of fruiting yet. This is often due to bad drainage and to scum and mess on the surface of the soil. But generally speaking, on a moderately well cultivated plantation, 100 nuts is not too much. It takes 250 to 325 nuts to make a picul, and there are 16 piculs to the ton. Some claim, with very large nuts, 200 to a picul. But during one year, when the soil had to do without rain, the nuts were so small that some of the factories said it took 500 of the nuts to make a picul.—PROCEEDINGS OF THE THIRD INTERNATIONAL CONGRESS OF TROPICAL AGRICULTURE.

THE SELECTION OF COCONUTS FOR SEED.

THE EDITOR OF THE TROPICAL AGRICULTURIST.

Dear Sir,

In remarking on SIMMONDS' directions for the selection of coconuts for seed you say "We are not aware how this quality of 'full-large eyes' could be detected in seed nuts which are always planted in husk." (Vide T. A. for May 1915, p. 284).

This could easily be detected by husking one nut of each of the trees from which seed nuts are proposed to be taken. If the eyes of a nut of any particular tree be "full," and "large" the rest of its nuts will invariably be of the same nature.

A similar test, viz., husking and opening at least one nut from each tree will be found necessary to follow the directions of the Board of Agriculture of British Guiana too, for the "thickness of the kernel" of a nut cannot *properly* be ascertained without having it opened.

Yours faithfully,
JAMES ALWIS.

Lunawa, Moratuwa,
May, 26, 1915.

INDIAN COPRA.

The value of the exports of coconut products from the Madras Presidency, which is the only coconut producing part of India worth considering, is, according to the INDIAN TRADE JOURNAL, £1,000,000, of which £650,000 goes to Germany. This represents an output of about 1½ million cwt. of copra, the equivalent of approximately 600 million nuts. An estimate of the total output of coconut products in South India (calculated as copra) is roughly 115,000 tons.

THE CASSAVA STARCH INDUSTRY.

MR. E. H. S. FLOOD, Canadian Trade Commissioner for the West Indies, in a recent report to the Department of Trade and Commerce, referred to the new factory erected by the Trinidad Produce Co., Ltd., for the manufacture of cassava starch This factory is capable of turning out annually 2,000 tons. In recent years increased attention has been devoted to this industry, and, in all, there are now three factories preparing cassava starch in Trinidad, one of which—the Palmiste—has recently come into operation and is equipped to turn out each year 10,000 tons. The difficulty at present is to obtain a sufficient supply of green cassava. There is apparently a large expansion of cassava-growing in these colonies. Each island has heretofore produced enough to satisfy its local demand, but as the soil and climate throughout the islands are well suited to the cultivation of this product, a general feeling prevails that a larger quantity should be grown, and an export trade built up. In Jamaica, St. Vincent, Barbados, and St. Lucia, a considerable quantity is grown for home use. St. Vincent is extending its cultivation and is looking to Canada for a market. Its present export of this starch amounts to £1,287. Jamaica is also exporting a small quantity valued at £1,049. Among the products recommended by the Agricultural Society in St. Lucia for extension is this tuber, and the Society is of opinion that an export trade could be created. The fact that starch is obtained at a very low price from the sago palm, which grows wild in the forests of the East, has prevented the West Indies from competing. In these eastern forests this palm grows in enormous quantities, but as the forest areas are being depleted and the land taken into cultivation, the price of sago starch is advancing and this now gives an opportunity for the West Indies. As an article of food, cassava has hitherto received less attention in the north than it deserves. Among the natives of Brazil and in the French dependencies, it takes to a large extent the place of wheat. During the next few years it is expected that a much larger supply will be available from the British West Indies.—WEST INDIA COMMITTEE CIRCULAR (Ap. 6).

RUBBER.

DECLARED PERCENTAGES IN RUBBER GOODS.

Touching the question of plantation versus Para rubber, a suggestion of considerable interest to the trade has recently been broached. It is pointed out that the user of rubber goods has no guarantee whatever as to the quantity of crude rubber, if any, contained in the articles he purchases. In connection with many other manufactures, definite guarantees are given, and it is contended, with some show of reason, that in these days of reclaim, rubber substitutes and what not, the purchaser of rubber goods is entitled to know a little more about the article he is buying. In view of the British public's large financial interest in the plantation industry, there is no doubt that, so far as this country is concerned, rubber goods endorsed with the legend "Made from pure plantation rubber" would command a better sale than similar goods unmarked. Assuming also that up to a certain point the more virgin rubber used in its manufacture the better the article, it is urged that manufacturers might go further and give the actual percentage of rubber contained in the goods. From the standpoint of plantation rubber producers, at least, the suggestion has much to recommend it. When prices of fine hard and plantation are on a par the user of the former is in reality paying approximately 25 per cent. more for his raw material, making allowance for loss in washing, than the buyer of plantation rubber. It is obvious, therefore, that the former could not compete with the latter on equal terms if the respective percentages of raw rubber in the manufactured goods were disclosed. I am convinced that there is a good deal in this suggestion, and that the trader adopting it would ultimately be well repaid for his enterprise. In the first instance, however, it would be necessary to educate the public by judicious advertising, explaining the relationship between the percentage of pure rubber used and the quality of the goods.—INDIA RUBBER WORLD.

SMOKED AND UNSMOKED RUBBER.

We have been taken to task for our remarks in a recent issue on the comparative values of smoked and unsmoked plantation rubber. We have repeatedly pointed out that, at best, plantation rubber is only superficially smoked, and that it shows a considerable loss on washing and also a high resin content. Nevertheless, we are quite aware of the advantages of having rubber smoked, especially where it is necessary to store the produce for some time. Furthermore, we freely admit that there must be something more substantial behind the market for "ribbed smoked sheet" than mere fancy, and that many manufacturers prefer sheet in the smoked condition. It is, however, advisable to keep all points of view before us. We were recently informed by MR. W. A. WILLIAMS, of the North British Rubber Co., that

"after repeated trials I have found that unsmoked biscuit or sheet gives the best all-round results, and is to be recommended for the reasons that for strength and uniformity it is quite as good as smoked sheet and undoubtedly superior to creped or blocked rubbers."

MR. WILLIAMS is not alone in the view he holds. MR. STANLEY MORRISON, of the Leyland and Birmingham Rubber Company, has publicly stated: "As to smoking we really do not mind much." The question, therefore, naturally arises whether the views of the particular parties mentioned represent the opinions of the manufacturing industry. It is quite possible that each individual is apt to base his convictions on his personal experience, which in turn is largely determined by the nature of the goods made by his own firm.

The advantages of smoked over unsmoked sheet accrue from quite a superficial treatment, and it may transpire that where manufacturers do not store but immediately use all the smoked sheet they buy, the improved keeping qualities of smoked rubber are of no real value. Any small advantage due to manufacturers who thus deal with their smoked sheets may be offset by the increased loss on washing and resin content noticeable in this class of rubber.

There cannot, we think, be any doubt as to the advantages of smoked rubber to the growers. Rubber so treated "travels" better, a fact which must not be lost sight of when produce has to be stored in ships and wharves for several months in tightly-bound wood cases. The absence of mould and freedom from tackiness of properly prepared smoked sheets would alone justify the process from the growers' point of view.—INDIA RUBBER JOURNAL.

CATCH CROPS WITH RUBBER.

A member who is planting in Travancore writes (23rd March) an interesting account of his experience in growing catch crops with rubber:—"I pass over the returns from cereals as they are always more or less speculative on account of their dependence on just the right amount of rain, which is by no means certain. Groundnut only gave a yield of 580 lb. per acre, which was disappointing. The reason for this was evidently that the soil was deficient in lime, as an analysis indicated. The only product that proved a distinct success was *Ginger*. This gave 3,400 lb. per acre. In drying this for the London market, 100 lb. raw roots gave 20 to 25 lb. dry, costing Rs. 1¼ for the process. The latest quotation is 25*s*. per cwt., which is approximately Rs. 100 per acre. The above yield was obtained from planting on ground previously dug up but not manured, so the figures may be fairly relied upon. The growth of the rubber in this area was not affected although the ginger was planted right up to its stem. *Robusta Coffee* was also a distinct success. I planted this out last June and some of the best plants have already blossomed, which was beyond my expectations, and for this reason ought to prove a most suitable product as a catch crop if not kept on too long. As I have planted the rubber 30 ft. apart between the rows, one row of coffee in the middle would not be injurious to the rubber, and the yield from the second year, or at most the third, ought to be more than sufficient to keep the estate going till the rubber came into bearing."—C. A. S. PROGRESS REPORT.

WORLD'S RUBBER PRODUCTION FOR 1915.

According to an acknowledged authority on the rubber market, the world's production of the commodity during the present year is not likely to exceed that of 1914. Last year's figures were approximately as follows:

Plantation, 71,977 tons; Brazil, 37,000 tons; rest, 12,000 tons; total 120,977 tons. Percentage of increase 11·5 per cent.

For 1915 the estimate in question is:

Plantation, 85,000 tons; Brazil, 30,000 tons; rest, 5,000 tons; total 120,000 tons. Percentage of decrease, ·08 per cent.

There are, however, so many elements of uncertainty in connection with the production of crude rubber that an estimate, however carefully compiled, may well prove to be wide of the mark by as much as 15,000 tons. For example, in view of the enormous area planted with rubber in the Middle East during 1910, and therefore now coming into bearing, there is bound to be a very big increase in the plantation outturn this year. The above authority gives the surplus as rather more than 13,000 tons, but it may quite easily run into 20,000 tons or more.

Then again, there is the unkown factor, Brazil. Notwithstanding an extraordinarily fluctuating market, South America during the past eight years has been a wonderfully uniform producer. Neither the high prices of the boom period nor the subsequent slump seems to have had much influence upon the outturn of Brazil. For 1910, when prices were at the high water mark, the total production of Para rubber was 40,800 tons, and in 1913, when the price pendulum swung to the opposite extreme, the total crop was 39,370 tons. Brazil is the most disconcerting and illogical factor in the crude rubber position, and it is just as likely to produce more, in a time of adverse market conditions, as less. One would suppose that if anything were calculated to upset the Amazonian industry it is the present European conflagration. It might reduce the production by as much as 50 per cent., but the odds are that it will not. The above estimate indicates a falling off of 7,000 tons from this source, but while the crop is just as likely to be equal to that of 1914, nobody would be surprised if it were 10,000 tons less.

As to the production of the rest of the world, there is bound to be a substantial reduction, and that is all one can say about it. However, it may be generally conceded that although individual items in the foregoing estimate may prove wide of the mark, the total, much on a par with that of 1914, is most in accordance with the probabilities.—INDIA RUBBER WORLD.

In pickling grain, says the QUEENSLAND AGRICULTURAL JOURNAL, one of two methods may be followed: (1) soak for two hours in 1 lb. formalin (40 per cent. formaldehyde solution) dissolved in 50 gallons water and then dry. (2) Put grain in a sack and dip for 3 minutes in a solution of 1 lb. bluestone to 5 gallons water. After draining put grain in another sack and dip for a minute or two in solution of 2 lb. lime to 10 gallons water. Drain and dry before bagging, using wooden receptacles for the dips.

CACAO.

COCOA FERMENTATION.

PROFESSOR PERROT.

In the notes published by me on the question of the fermentation of cocoa, I have considered this fermentation from two points of view: (1) That of simplifying if possible the preparation by rendering it more methodical and more rigorously scientific without increasing the net cost of production; (2) that of supplying to the consuming industry a regular product always of uniform quality.

The treatment of the pulp by carbonate of potash shows that this pulp can be more easily removed than would appear believable, for it must not be forgotten that the method of fermentation as at present practised is almost as primitive as in the time of the ancient Mexicans.

From researches which I have been able to make, it appears that this fermentation is not necessary in order to obtain an industrial product. In fact, if a current of steam at low pressure is led into a suitable enclosed space in which fresh cocoa beans have been placed, and the beans are left in contact with the steam, the beans become sterilized—stabilized, as we say —and are thereafter incapable of spontaneously undergoing any chemical change.

By stabilization in steam under pressure for ten minutes beans are obtained which, after being washed and brushed to remove the pulp, are dried and will then keep in good preservation without change, whilst at the same time retaining their fine natural violet colour.

There is good reason for asking if beans thus treated could be used in the chocolate industry, for it has been claimed that the flavour of the bean is obtained by fermentation.

I have therefore had 200 kilograms of cocoa sterilized at the Ivory Coast and have submitted it through one of the largest French chocolate firms to industrial treatment.

To the astonishment of those who were entrusted with the roasting, the cocoa became fragrant and was in no respect inferior to the products obtained by fermentation in the same region.

Here, therefore, is a series of experiments, showing that the fermentation of the cocoa seems to be of no advantage for obtaining an excellent product for manufacturing purposes, and I believe that I may say that sterilization would have the double advantage of not raising the net cost of production, whilst it would also assure to manufacturers a remarkable regularity in the production of each plantation.—PROCEEDINGS OF THE THIRD INTERNATIONAL CONGRESS OF TROPICAL AGRICULTURE.

TEA.

INVESTIGATIONS ON THE MANUFACTURE OF TEA.

S. SAWAMURA.

I.—Effect of Steaming on the activity of the Enzymes of Tea Leaves.

The leaves contain an abundance of oxidising enzymes which produce a black colour during the fermentation. The destruction of these oxidising enzymes by steaming results in a green tea.

Among other enzymes in tea leaves is diastase, which may be extracted in 40 per cent. alcohol and precipitated in ether alcohol.

By subjecting various samples of tea to steam for different periods and testing for oxydase, the writer found that the oxydase loses its activity when steamed for 30 seconds, but retain its diastatic power. It is therefore very probable that enzymatic action takes place in the first stage of rolling tea leaves and that the production of a fine aroma is due to this.

II. Effect of Rolling on the Solubility of Tea.

The object of rolling the leaves in the manufacture of green tea has not yet been determined. It may be to give the tea a fine shape, or to press out the juice to accelerate drying, or to break the cells in order to increase the solubility.

Samples of green tea were prepared with and without rolling and the qualities of their infusion compared.

The infusions of the rolled tea was of a deeper colour, and had a stronger flavour and better taste than that of the unrolled tea.

This difference was also apparent in the amounts of soluble matter in the infusions, which were as follows :—

	Percentages of the total amounts of each constituent in the original samples.	
	Unrolled (Tencha.)	Rolled (Gyokuro.)
Dry matter.	23·021	31·656
Nitrogen	31·869	34·427
Tannin	8·216	34·374
Thein	63·559	79·453
Ash	64·083	63·708

These differences in the amounts of soluble matter in the infusions of rolled and unrolled tea disappear when the samples are powdered before extraction. Hence it is concluded that rolling has the effect of increasing easily soluble matter by crushing the cells and pressing out the juice so that it dries on the surface of the leaves.

III.—Effect of Firing on the Chemical Composition of Tea.

Refiring improves the flavour and colour of both green and black tea. Experiments were made with samples of tea fired at different temperatures for different periods. It was found that the optimum condition for firing green tea is a temperature of 70° C. for one hour and for black tea a temperature of 80° C. Higher temperatures spoil both flavour and colour. The solubility increases slightly at moderate temperatures, but at higher temperatures the total soluble substance and tannin decrease remarkably. The tannin is destroyed by oxidation and a decrease of thein takes place owing to volatilisation.—MONTHLY BULLETIN.

TOBACCO.

NICHOLAS SACHOULIS.

HARVESTING.

Six weeks after topping, the crop is generally ready for harvesting. Tobacco is ripe when grown up, and the leaf shows brown spots and a rough surface. The leaf is very brittle, breaking readily when doubled up.

Now begin the most particular operations of the whole process of making tobacco, for it is now that you must fix in the leaf the desirable qualities that go to make a valuable product, such as elasticity of leaf, flavour, colour, etc. Cut your tobacco in the afternoon, but not after heavy rain, nor it dew is on the plants, neither when the rays of the sun are very hot. Rain washes the gum off the tobacco, therefore wait a few days for it to gather gum again.

In hanging tobacco on the stick, it should not be put closer than three to five inches apart, according to the size of the plant.

Remarks.—If you desire your tobacco to have a good colour, bright, golden red and mottled, hang your sticks in the shed very close, from four to six days, till leaf and stem have become perfectly limber and yellow.

SUN-CURING TOBACCO.

Then remove your sticks on the scaffold for a week or two, hang them from 6 to 10 in. apart. When the colour is good enough and the leaf getting dry—i.e., when the sap is leaving it—the poles are transferred to the shed and placed in position, there to hang till nearly all the sap has left it. In sun-curing the leaf should never be allowed to get wet either by rain or dew.

FLUE CURING.

The leaf at the time of harvesting contains a large amount of water, but it is evident that the curing is something more than drying, for a leaf dried out rapidly by heat has few of the desirable properties of a well-cured leaf. Again, a leaf dried under the right conditions in "sun-curing" weighs much less than would the same leaf if dried out quickly. The most important fact to keep in mind is that the leaf must be kept alive till the first stage of the curing is completed, till yellowing begins, and this brings us to the question of the most favourable condition for curing.

The primary object of flue-curing is to produce bright colour in the leaf, but on the drying winds of South Queensland it is becoming evident that heat has a value in the curing of dark tobacco, if for no other reason than to remove the greenness so common in much of the air-cured leaf.

Turkish tobaccos have been commonly sun-cured, but experiments conducted during the past season indicate that these tobaccos can also be cured in the flue barn. By this method the loss due to unseasonable weather is avoided, the colour is brighter and more even, and, as far as can be judged, there is no loss in flavour or aroma. When harvesting tobacco for flue-curing we prefer to prime the leaves that are fully ripe. The tobacco is then carried in baskets to the barn, where it is tied on sticks with wire or string. The barn

should be filled as rapidly as possible, for if a portion of the leaves becomes wilted while the remainder are still fresh, it is almost impossible to cure a barn of even bright colour. As soon as the barn is full, start a slow fire in the furnace, and slowly bring the barn up to a temperature of 90° Fahr. A hot fire at the start will ruin much of the tobacco in a few minutes, therefore the temperature of 90° should be maintained until the leaf has yellowed. When the leaf is ripe and sappy, and has been grown on a sandy soil, this will not be difficult, but where the leaf has made a slow growth and is leathery, it often refuses to colour. In the latter case increase the humidity of the room by sprinkling water on the flues until the air feels moist. The yellowing stage will require from twelve to twenty-four hours, and so long as the temperature does not run over 100°, the fire will not require much attention. This, it must be remembered, is for tobacco that will not yellow, and does not apply to bright colour.

The second stage of flue-curing is that of fixing the colour at 100° in four hours.

After the temperature has been slowly increasing for from fifteen to twenty hours, and the leaf has lost the greater portion of its moisture, it will begin to dry at the tips and around the edges. Where this drying is general throughout the barn, the second stage may be regarded as at an end. The temperature at this point, raised 2 degrees every hour, should be about 120° Fahr.

The third stage simply consists of the rapid drying out of the leaf, and is commonly called the "killing" of the leaf. The temperature is increased from 120° to 135° or 140° Fahr., at the rate of 4 or 5 degrees an hour, and is held at the higher temperature until the midrib is perfectly dry and brittle. During this stage the ventilators are partially open, but inasmuch as less moisture is escaping than during the sweating stage, and because of the great draught due to the heat, they are not fully open. Wide-open ventilators mean a large consumption of fuel. If the tobacco has not been primed, but the whole plant hung, the temperature is then increased to 160° or 175°, and continued until the stalk is dry. No moisture must be left in either the mid-ribs or stalk, as this moisture will in time run back into the leaf and result in red streaks.

As soon as the drying is finished and the fires are drawn, the leaf may be rendered pliable by running steam into the room, after which it is taken down and removed to the packing house, where it may be bulked on the curing sticks and handled at a later date.

Turkish tobacco, being light and thin, changes much more rapidly than Virginia leaf (pipe tobacco), and all the stages are of shorter duration. The same high temperatures are not required, and 120° is the highest temperature that we care to use for this type of leaf. The leaf dries rapidly, and the ventilators need never be fully open. The beginner usually makes the mistake of attempting too much. A year or two is required before sufficient experience is acquired to justify the planting of large fields.

The cost of flue-curing barns need not be excessive if the farmer or his assistant does the work, but a builder or contractor expects to make a good profit, and the tenders are often enough to frighten a man out of the tobacco business.

It may interest growers to know that the barn should measure 25 ft. by 30 ft. and 20 ft. high. The cost would be from £30 to £40, and such a barn is sufficiently large for an average crop of 10 acres.

Good tobacco can only be made by good curing, and good curing can come only by experience and close observation.—Queensland Agricultural Journal.

HINTS TO TOBACCO GROWERS.

1. In selecting plants for seed it is well to select those standing a good distance apart from one another to avoid seed resulting from cross-fertilisation by the aid of air currents or insects which travel from flower to flower conveying pollen. Care should be exercised in selecting the plants, and only those having the greatest number of good qualities should be chosen.

2. The seed should be well matured, and all light and faulty seed removed by winnowing in a light breeze.

3. Nursery beds should be carefully prepared in a rich light loamy soil, and well enriched with manures to give a quick, healthy growth to the seedlings.

4. The seed should be mixed with wood ashes or finely pulverised earth to give sufficient bulk so that the seed may be evenly distributed over the nursery. Sow at the rate of a heaped teaspoonful of seed to five square yards of nursery. Cover the seeds by trampling the soil or pressing it with a board. If the plants come up too crowded they should be thinned early to prevent a spindly growth.

5. It is well to erect a thin shade over the nursery but at a sufficient height to prevent attracting insects to the seed bed. The nursery should be watered in the early morning and late evening. It is a bad practice to allow weeds on or near the nursery as they attract insects and affords them a hiding place while they feed on the young plants.

6. New land is preferable for tobacco. The first ploughing should be fairly deep to increase the moisture-holding capacity of the soil. When preparing the soil for transplanting, deep ploughing is undesirable, but the surface soil should be brought to a well-pulverised condition.

7. It is not advisable to apply large quantities of cattle manure, especially when the tobacco is intended for cigar purposes, as this tends to produce a coarse, rank quality of leaf.

8. Transplanting should be done when the plants are from four to five inches high, and care taken that the roots are not twisted or bent in the operation.

9. If the seedlings from the nursery are strong and vigorous, having a short thick stem, and transplanting is done early in the season, it is unnecessary to shade the plants. Their growth and quality are not impaired by a reasonable amount of withering at transplanting time.

10. In localities where watering is required, it is best to scoop a shallow hole by the side of the plants into which water is poured near the roots, and as soon as the water has settled the loose earth should be replaced but not pressed down hard. This prevents the rapid escape of moisture and baking of the earth by the sun. Watering done in this manner may be less frequent than if water is poured directly on the plants.

11. Tobacco requires frequent shallow cultivation.

12. Chewing tobaccos are topped to give a larger and more fleshy leaf, while cigar tobaccos should not be topped, as a thick leaf is undesirable for tobacco making.

13. In the harvesting of chewing tobacco, the plant may be harvested by splitting the stalk and cutting the entire plant at one operation. Cigar tobacco, especially if intended for wrapping, should be harvested by the priming method, that is picking the individual leaves from the stalk.

14. Picking should commence with the ripening of the lowest leaves. Care should be taken not to bruise the leaf, because a bruised leaf can never be properly cured.

15. After picking, the leaves should be carried to the curing shed and strung up on strings away from a strong wind, which would cause too rapid drying. There should be no crowding of the leaves on the strings.

16. When the leaves, including the stems, have thoroughly dried, they should be taken down, classified according to quality, color and size, and tied in bundles to be fermented for five or six months, at a maximum temperature of 135° Fahrenheit.

B. F. SCHERFFIUS.

SUNFLOWER-GROWING FOR SEED.

The sunflower will grow in almost any soil and in any climate. It will bear cold or heat, drought or rain. It is subject to no disease, and to no climatic disqualification. The cultivation is very simple. As stated, the plant is not at all particular, but prefers light, rich, well-drained soil. It is advisable to sow early—say, the beginning of September—to secure perfect maturity. The quantity of seed required per acre will vary from 4 to 6 lb. It should be sown in drills, 5 ft. between the rows, and the seed drilled or dibbled in at intervals of 3 ft. The plants may afterwards be thinned out, if found necessary owing to exuberant growth, to ensure full exposure to the sun—a very necessary condition. As the plants have a habit of spreading their branches and heads in successive layers over each other, thinning is generally necessary. When 12 in. high, a slight earthing up benefits the plants. Sunflowers with many heads do not ripen the seed evenly, therefore it is better to cultivate a species producing only one large head to each plant.

The Tall Mammoth Russian is such a variety, and may be planted closer. It produces more seed than any other sort, and can be obtained from most seedsmen in Brisbane, and probably elsewhere.

A yield of 50 bushels per acre is not uncommon under favourable conditions. The Mammoth; or Giant Russian, has often produced flower heads 15 in. in diameter and bearing over 2,000 seeds.

The leaves of the sunflower, when sun-dried and pounded, and mixed with meal or bran, make good fodder for milch cows. The oil expressed is almost equal to olive oil.

We are not sure of the wholesale price now ruling for the seed; before the war it was quoted at £ 12 per ton.—QUEENSLAND AGRICULTURAL JOURNAL

RICE CULTIVATION.

THE IRRIGATION OF RICE IN CEYLON.

J. A. BALFOUR, A. M. INST., C. E., DIRECTOR OF IRRIGATION, CEYLON.

[*Paper read before the Ceylon Agricultural Society, May 25th, 1915.*]

It is proposed in this paper to describe, briefly, some of the methods and customs followed in irrigating rice crops in Ceylon.

Speaking generally, irrigation is a necessity for the successful growing of rice. It is true there are varieties of the plant which may be grown without irrigation, but these do not appear to be favoured unless irrigation is unobtainable, and by far the greater portion of the world's supply of rice is grown with the assistance of irrigation.

In Ceylon, in those districts where there is ample rainfall, it is necessary for the rice grower to arrange for the watering of his crop during the comparatively short dry intervals which occur during the cultivating seasons ; so he dams up the natural perennial streams until the water may be made to flow over the fields. The irrigation works usually consist of a dam, either permanent or temporary, across a river or stream, and this dam diverts the water into a channel cut with a gentle gradient along the valley side. The gradient of this channel is made less than that of the river or bed of the valley so that, gradually, as one goes down the channel it is found to be higher and higher above the river and also a greater distance away from it. The land between the channel and the river is irrigable and is said to be "commanded" by the channel. It is invariably divided up into liyaddas or level terraces with small banks around their borders to retain the water, which is allowed to flow into them from outlets at suitable points in the channel. Any surplus or wasted water drains away through gaps cut in the small banks into the river.

There are numerous works of this description in the Western, Central, Sabaragamuwa and Uva Provinces. In these works the earth channels themselves were generally constructed, with a considerable amount of skill, by the people, and in a very great number of cases Government has given assistance by constructing permanent dams or anicuts on the rivers, so that the irrigators may not be compelled repeatedly to reconstruct temporary dams after they have been destroyed by every freshet. In all cases, but particularly in hilly country, the channels are liable to be badly damaged by the water flowing off the hillsides above them, and here again Government has assisted the irrigators by constructing works to carry the water over or under the channels without damaging them.

The earthworks of such channels are usually maintained by the cultivators, the Irrigation Department carrying out such repairs to the masonry works as may be necessary from time to time.

The distribution of the water is managed by the people themselves, a special village headman being appointed, whose duty it is to see that the

water is fairly distributed according to the local irrigation rules which embody the ancient irrigation and cultivation customs. In return for his trouble, this headman, in most cases, receives a small share of the crop, and he is himself generally a cultivator owning a portion of the irrigated fields. As a rule, the water supply is ample and the area under command small, so that there is little conflict of interests and this system of management is generally satisfactory. However, it is regrettably common to find the channels so neglected that some or all the irrigators suffer loss. It appears to be increasingly difficult to enforce the labour contributions necessary for the proper upkeep of the works, partly because of the weakening of the village community system and partly because outside landowners are gradually acquiring a greater share of the village lands.

REASON FOR IRRIGATION.

Irrigation of the foregoing description is practised over the south-western quarter of the Island. Over the remainder of the Island the rain which falls in a comparatively short wet season must be stored to supplement the scanty rainfall of the dry season. It may be asked : Why not cultivate without artificial irrigation in the wet season ? The answer is that rice must receive a watering at intervals of not more than ten to fourteen days, while there may be rainless intervals of longer duration than this even in the wet season ; that the rainfall is too irregular to allow of the systematic and even watering which the crops require ; that in the wet season the irrigable area is very often subject to floods which may destroy the crops ; and that the total rainfall in the wet season may itself be insufficient for the proper watering of the crop. It is often stated by cultivators that, apart from these disadvantages, the wet season is not favourable to the growth of paddy ; but the writer has never been able to discover any satisfactory basis for this statement, which, moreover, is contradicted by other cultivators. A very real objection to cultivation in the wet season in some districts is that, as cultivation cannot commence before the rains provide sufficient water for ploughing, the paddy cannot reach a mature stage before the windless season immediately following the monsoon, and the crop in young ear is then subject to attacks by paddy fly. This is a valid objection and it may be taken as granted that, if possible, crops should never be in young ear at this time of year. The danger of partial or complete loss of crop is great, and the known protective measures are costly and not very efficient. It may be noted, however, that the Jaffna cultivator successfully grows on low-lying ground a crop of paddy in the wet season without the aid of irrigation. The flat low ground receives the drainage from adjacent higher lands, and this, combined with the high level of the subsoil water plane in the wet season, is a substitute for irrigation proper.

The portion of the Island where irrigation is carried on by means of stored water is that in which the greater part of the rainfall occurs in the North-East Monsoon during the months of November to March, and includes the Northern, North-Central, Eastern, the eastern portion of the Southern and the northern part of the North-Western Provinces. In addition to this area, there is the Matara district of the Southern Province and the Kurunegala district of the North-Western Province, with a fair rainfall in

both the North-East and the South-West Monsoons, where stored water is used. In these districts the rainfall is supplemented by the stored water, and the crops are rendered independent of the vicissitudes of the weather. There is also one large irrigation scheme in the Eastern Province, the Pattipola Aru Scheme, where stored water is used to supplement the rainfall and natural flow in the rivers. The river on which this scheme is situated rises in the Uva hills where it is called the Gal-oya, and it flows nearly all the year round. Towards the end of the irrigating season, however, the flow is insufficient for the requirements of the crops ; and it is then supplemented by the water drawn off from the river and stored in the tanks during the floods, when the water available is much in excess of requirements, and is, in fact, the cause of much difficulty and loss. The tanks are constructed in branch valleys, leading into the main river valley.

THE STORAGE TANKS.

A storage tank, whether a small village tank irrigating five or six acres or a large reservoir capable of irrigating several thousands of acres, is of one general type, varying only in details and magnitude. A dam, generally of earth, is built across a suitable valley thus damming up and retaining the water which would otherwise flow away down the valley to the sea. The water held up must not be allowed to flow over the top of this dam, so a spillway, or safety valve, is provided at a level somewhat below the top of the dam to allow the flood or surplus water to flow harmlessly away before the level of water in the lake rises dangerously high. This spillway is cut in hard earth or rock or is built of masonry. The stored water is issued to the fields by means of a sluice near the bottom of the lake, and flows in a channel or channels along the valley sides below the dam, irrigating the lands between itself and the bottom of the valley. A variation of this type is to be found where, the flow of water in the valley being insufficient to fill the reservoir, the flow from another valley is diverted into it to supplement the insufficient supply.

The earthwork of a village tank is usually constructed by the communal labour of the villagers, and as a rule, the ruins of an ancient dam are used as a basis for the work. The breaches in the old work are filled up, the top brought to an even level, the slopes of the bank strengthened and the spillway cut. The sluice, and the masonry spillway if one is required, are constructed by Government, which also supplies the necessary supervision for the earthwork. In backward districts requiring assistance the sluices and spillways have been supplied free of cost to the cultivators, but in other places the people are required to repay their cost in instalments. The earthwork is contributed by each landholder in proportion to the extent of his holding under the tank. In the North-Central Province the maximum liability per annum amounts to about 6 cubes or about 22 cubic yards per acre per annum, say from 6 to 15 days' work according to circumstances, but it varies in amount because the areas of land are not definitely known. Until the tank is completely restored, it is usual to call out the full quantity of work yearly and thereafter sufficient only to maintain it. The restoration itself may, and often does, take many years, and owing to the piecemeal nature of the restoration considerably more work has to be done than would otherwise be necessary, for every year a

little of the newly finished work is washed away. The people do not like this tank work, and where they are able to afford it employ wandering gangs of Indian earthwork coolies (Oddars) to do it for them. The yearly tasks are set out for the people by subordinate Irrigation Officers placed under the Government Agent for the purpose.

The larger storage tanks are constructed entirely by Government, and the owners of the lands irrigated by them pay rates which are supposed to cover the cost of maintenance and interest on the cost of construction.

Storage works are costly to construct either in labour or money or both, and when built the supply of water is limited by the capacity of the reservoir. The cost increases with the quantity of water stored, and it follows that, for Government to obtain the best results for the expenditure, or the villagers for their labour, no more water should be used than is necessary for the proper maturing of the crops. If water is wasted it shows that a given area might have been irrigated at a less cost; or for the same cost a greater area might have been irrigated, thus conferring greater benefits on the country.

In the case of village tank works, the management of the water is left to the people themselves as already described for channel works. The area to be irrigated is generally small, the people are known or related to one another, and the customs which guide the distribution are the outcome of centuries of experience. In spite of this the results are very variable. In remote Singhalese districts where the communal feeling is strong the results are fairly good, but this is not the case when the village tank is supplied from a major work ; for then, as far as the villagers are able to see, water is abundant, and no care is taken of it. Where the village community has been weakened, or where there has been an influx of outsiders, there is frequently loss and delay owing to the uncontrolled selfishness of some of the cultivators. The writer considers that, on the whole, the present system is suitable for village works, and that it would not be easy to find a substitute for it; but where the communal system has become weakened it is a question whether, for the protection of the cultivators as a body, steps should not be taken for the better enforcement of the rules by administrative order.

SYSTEMS OF MANAGEMENT.

On the larger rate-paying works control of irrigation by the village communities is not practicable, for these there may be irrigated the fields of many villages with conflicting interests, and between whose claims impartial outside judgment is necessary. Again, the boundaries of the irrigable areas are fixed by topographical and other physical causes and do not coincide with the village boundaries; while in many cases village communities do not exist at all within the irrigable area, the land being held in large blocks the owners of which are often absentees; and not infrequently the cultivators as well are only temporarily resident while work proceeds on the crops.

For such works there are at present three systems of management in force :

(i) The management of irrigation as well as the cultivation is controlled, generally, by the Government Agent in accordance with irrigation rules passed for the work or for the whole district in which it lies. This control is exercised through the Chief Headmen, who have under them special minor irrigation headmen who are paid in kind by the cultivators themselves.

The rules are sometimes passed at meetings of the cultivators, sometimes by a committee of cultivators acting for the whole District or Province, and sometimes, where the people cannot be got together to hold meetings, by the Government Agent. They generally embody the old irrigation and cultivation customs of the districts. If the irrigated area is large, a subordinate Irrigation Officer, called the Irrigation Superintendent, is placed under the Government Agent to carry out the management, and the minor irrigation headmen then work under this Officer.

(ii) The management of both irrigation and purely cultivation matters within the irrigated area is placed under the Director of Irrigation, who, in consultation with the Government Agent, draws up irrigation and cultivation rules. These rules are enforced by the special irrigation headmen working under the Irrigation Engineer in charge of the works, and in such cases the Irrigation Engineer is usually assisted by an Irrigation Superintendent.

(iii) A third system has recently been introduced, under which the control of water management or irrigation proper is in the hands of the Irrigation Department and the control of purely agricultural matters in the hands of the Government Agent. The control of the water is then effected by officers of the Irrigation Department and the control of agricultural matters by the minor headmen referred to above, who are under the Government Agent, and who are paid by shares of the produce.

The working of one of these systems will be outlined, but the effect of certain practices on the quantity of water used for irrigation will first be noticed.

LATE CULTIVATION.

Cultivation should commence as soon as possible after water becomes available. The waste caused by undue delay may be demonstrated by the following example of a tank filled by the North-East Monsoon.

While a tank is filling, while the water in it is lying unsued, and during the time the water is being drawn off for irrigation there is a daily loss of stored water caused by evaporation from the surface of the lake and by the soaking away of water into the ground. This loss varies with the local circumstances, but in the hot dry region of this country may be taken as a quarter of an inch off the depth daily. Thus it will be seen that if the irrigators delay cultivation, the quantity of water they will have available will steadily diminish even if unused, while, in addition to this, more water will be required to soak the fields for ploughing and for the growth of the plants. The writer has calculated the irrigating capacity of a large tank in the North-Central Province, on the assumption that no appreciable quantity of water is wasted in irrigation itself, with the following results :—

For a rice crop grown during the months November to February, inclusive, the scheme will irrigate.....9,000 Acres.

If cultivation is delayed and takes place during the months March to June, inclusive, it will irrigate.....5,900 acres.

If cultivation is still further delayed and is carried on during the months of June to September the area which can be irrigated will be.....4,600 acres or about half the area which could be irrigated in the earlier part of the year. The case taken is one comparatively favourable to late cultivation and it would be easy to cite cases where the proportional area for a late crop was one-fifth or one-sixth instead of one-half.

It may be argued that it is desirable cultivation should be spread as evenly as possible over the year so as to give regular employment to men and cattle, and this is granted ; but unfortunately a common practice is to take advantage of the irrigation works to delay *all* cultivation to a late season. Even when cultivation is distributed throughout the year it is the tank which enables the cultivator to do with less hired or family labour and with fewer cattle, so that a direct pecuniary advantage is conferred on him ; but at the same time this advantage deprives other potential cultivators of any irrigation at all. Undoubtedly the late irrigation should be paid for at a higher rate in order to provide funds for the irrigation of lands suffering thereby.

QUANTITY OF WATER REQUIRED.

With regard to the actual quantity of water required for rice cultivation, no general rule applying to all conditions and soils can be given, but the following data may be of interest. Experiments were made by the writer in 1904-05 on a small area of paddy field in the North-Central Province. No water was wasted, but otherwise the cultivator was allowed as much as he asked for. The crop was grown after the North-East Monsoon, and 31·6 inches in depth of water was run on to the land. The rainfall during this period was 8·54 inches, so that the total depth of water required for the irrigation of the paddy was 40·14 inches. The paddy was "three months" paddy and the irrigating period was 110 days. The detailed figures showed that 16 inches of water were required during the first month and 12 inches during each of the succeeding months.

In the following South-West Monsoon the water used for irrigation on two separate tracts of fields was measured, and it was found that in one case 32 and in the other 38 inches of water was run on to the land. The rainfall during the irrigating period of 117 days was 9 inches, so that the water required by the paddy was 41 inches in one tract and 47 in the other. These fields were chosen for the experiments because water was not plentiful and reasonable care was taken in its use.

From these and other data it appears that, on average paddy lands, 16 inches in depth of water is required for the first month and 12 inches for succeeding months of irrigation. Consequently, the quantity of water required varies with the nature of the paddy—a six months' paddy for instance will require nearly twice as much as a three months' paddy. As a rule the irrigating season is of longer duration than the time taken for the crop to reach maturity, for although watering does not proceed up to the day of reaping, yet a certain period is required for preparation of the fields, and this is not usually done at one time for the whole field.

WASTE OF WATER.

The following are some of the causes of waste of water :

(a) The watering of a whole tract of fields while cultivation proceeds in a limited area only, and the passing of water through wide stretches of uncultivated fields to cultivated areas, instead of by means of field channels.

(b) Allowing water to flow continuously through the fields instead of filling up the liyaddas or terraces and then shutting off the water. It is sometimes objected that standing water is bad for the crops, but without any theorising there are numerous practical examples of high class cultivation where no water is wasted in this way to disprove this statement. The fact is that trouble in regulation is avoided by allowing the water to run continuously through the fields. As an example of this class of waste, on one occasion the writer found that the water running to waste from less than 1,000 acres of cultivation was sufficient to irrigate a further 1,200 acres.

(c) Insufficiently prepared terraces. These are not properly levelled off, so that to submerge the higher portions by 1 or 2 inches the water must stand deep in other portions, sometimes as much as 12 or 15 inches. This in itself may not be very wasteful of water, but while the crops are young the water must be frequently run off to save the plants in the low portion of the terrace from being drowned out. The practice moreover is bad for the crops, as neither the high nor the low portions can be properly irrigated.

(d) No proper system of rotation in watering, so that isolated blocks scattered over the irrigable area require water at one and the same time. Irrigation should be carried out in rotation, compact blocks of land being watered at a time.

(e) Sometimes waste is caused by defects in the irrigation works themselves, and generally these defects take the form of insufficient means of regulating and distributing the supply. The difficulty occurs chiefly where the works have been built piecemeal by Government, the landowners repaying the cost. There is no machinery for providing the funds necessary for improvements to benefit additional lands, or a section only of the irrigated lands.

As regards the actual depth of water which should stand in the terraces, both good practice and direct experiment show that there is no advantage in having the depth much more than 1 inch. An advanced rice grower informs the writer that the crops are benefited if the soil is aerated occasionally by allowing the water to dry or drain off, but the water must be run on again to drown the weeds which soon spring up before these grow too high. This the writer observes to be the practice in some parts of the Island.

The cultivator should not however depend on irrigation to kill off weeds which have been allowed to exceed 2 or 3 inches in height. On one occasion a cultivator, whose fields were knee deep in water, complained that there was not enough water because that depth was insufficient to submerge the weeds.

DUTIES OF IRRIGATION OFFICERS.

Having referred to some of the considerations to be borne in mind when dealing with rice irrigation, the actual procedure where a work is managed by officers of the Irrigation Department will be described.

On the approach of the usual season for irrigation, the Irrigation Engineer in charge calls a meeting of the proprietors to decide :—

(a) When cultivation shall commence and end.

(b) What areas shall be sown and the nature of the crops to be planted.

(c) What labour is to be contributed for any temporary channels required and by whom.

(d) Where the cattle are to be kept while the crop is growing, and sometimes other matters.

The meeting is presided over by the Irrigation Engineer or by the Irrigation Superintendent, who is the officer in direct charge of irrigation. The decisions are generally arrived at by majorities of the landowners unless otherwise provided for by the rules. It is the Irrigation Engineer's duty to see that the decisions do not unduly favour any particular set of fields or proprietors; for instance, if owing to shortage of water on one occasion, some fields have to be left unirrigated, if possible the same fields should not be deprived of irrigation on the next similar occasion. Such matters should not be left to a general vote of the parties interested ; for it is quite clear that, if the question lies between two tracts of fields, A and B, one of which is larger than the other, the larger area will always obtain the advantage. It is generally the case that there is sufficient water for all the lands for the wet weather crop, but not for the succeeding crops, and it is

here that the services of an impartial referee are essential. It may be remarked that in all countries where irrigation is successfully practised, the distribution of water is controlled by officers who have no local interests, who are conversant with the details of irrigation, and who must reside in the vicinity so as to be able to arrive at decisions on the spot.

Once irrigation of the fields has commenced, it is the duty of the irrigation officers to see that it is carried out systematically; that the technical considerations leading to economy of water are not neglected, that each irrigator receives his proper quantity of water but that no one is allowed to waste it, and that data are gathered to form a sound basis for the extension of the irrigable area. It is also their duty to decide whether extensions of time for completing joint labour should be allowed. Such extensions usually mean extra labour for the whole body of irrigators, and not only those directly benefited; so that the matter cannot properly be left to the general vote.

Offenders against the rules are usually tried before the nearest Village Tribunal of the District, or by a Village Council held for the purpose. The cases are instituted by the Irrigation Superintendent or one of the minor irrigation headmen acting on the orders of the Irrigation Engineer. As a rule these offences are neglect of some communal duty, such, for instance, as the cutting of a share of a field channel. In such a case the work cannot wait, and it is carried out immediately by the Irrigation Engineer or his officers, and the cost is afterwards recovered from the offender.

If the works are managed under the third system referred to, i.e., if the water is controlled by the Irrigation Officers, and the purely cultivation questions by the Government Agent or his Officers, separate sets of rules are drawn up for the management of these matters, the irrigation rules being enforced by the irrigation officers, and the cultivation rules by the Government Agent or his headmen. In such cases the area to be irrigated and cultivated for each crop and the dates for the beginning and end of irrigation are settled by these officers jointly in consultation with the cultivators, the actual practice being to allow as much latitude in these matters as is consistent with fair treatment all round.

For all but simple works, the management of the water should be in the hands of the persons responsible for the construction and maintenance of the works. It is impossible properly to design a system of distributaries without first preparing a scheme of water distribution, and without a knowledge of the requirements of the lands. The writer attributes many of the defects in existing irrigation works to the fact that the designers were not engaged in irrigation and were not experienced in irrigation management or the requirements of the crops. Moreover, there are many technical considerations involved in distribution. As an instance it may be mentioned that for a certain cultivation under Giant's Tank $17\frac{1}{3}$ feet in depth of water were issued to the fields. The following year the engineer in charge altered the system on technical grounds, with the result that 8·6 feet only were required. With this knowledge it will be possible to arrange for a much increased area of cultivation with the same amount of water.

The writer does not suggest for a moment that the present management of irrigation is perfect. It is far from being so. The Irrigation Department has been directly concerned in it for a period of about 8 years. At first there was no information or experience available to guide it. This had to be gained and the whole complicated subject had to be studied. In the meanwhile the old customs were carried on, abuses were remedied or removed, and obvious improvements made; and while there has already been an advance there is no doubt that the systematic study of irrigation will be the means of conferring on the paddy growers as a body much greater benefits in the future than they have secured in the past.

SOME LESSONS FROM EGYPT.

D. S. CORLETT, MANAGER, EXPERIMENT STATION, PERADENIYA.

[*Paper read before the Ceylon Agricultural Society, May 25th, 1915.*]

Referring to the article on Rice Cultivation in Egypt in the TROPICAL AGRICULTURIST for February, I should like to add a few remarks especially with regard to the statement in MR. W. A. DE SILVA'S paper (read at the last Society's Meeting) on local agricultural practices, referring to an unlimited supply of water for paddy.

All paddy is grown in Egypt by irrigation, and when there has been a poor flood, it means the supply of water will be limited. Naturally the more important crops of cotton and sugar-cane have first claim on the water available, and in consequence the paddy is left with a scanty supply. Thus the cultivator has perforce to learn to conserve his water and use only what is necessary.

In Egypt the water is never kept flowing continuously over the land, and never deeper than two inches. For the first fortnight it requires constant fresh water, but after that the same water can remain on the field for a week before being reflooded. By this means the roots get a firm grip on the soil as it gradually dries.

From flowering to harvest less and less water is given, and 10 days before cutting the land is entirely dried off. In consequence the growth is sturdy and upstanding, rendering the crop easy to cut. But in the flat, low-country parts of Ceylon the first thing that strikes the observer is that much of the paddy crop is lying prone in the water of the fields. The probable reason for this is that so much water has been allowed on the land that it has become sodden and water-logged, and the plant being weakened and unable to support the heavy heads of grain, the crop is beaten down by wind and rain.

The consequence is much grain is lost by sprouting in the water or becoming mouldy and rotten when stacked on the threshing floor in a wet condition, and the resulting straw is of very inferior quality. Again, the labour of reaping wet and prone paddy must be twice that of cutting it dry and upstanding.

Secondly, in these flat, non-terraced lands there are no drains, and in consequence the land *must* become water-logged and sour. Egypt has long ago recognised this grave danger, that over-irrigation results in sour soil. The water beneath the surface cannot drain away and becoming stagnant prevents the roots from properly assimilating their food to the serious detriment of the plant.

In Egypt will be found a deep drain parallel with every canal. Thus all surplus water is carried off, and the fresh water permeating through the soil to the drain supplies fresh stores of oxygen to the roots. In fact as much importance is attached to good drainage as to irrigation, and just as big dams,

reservoirs, and pumps are erected for raising the water on to the land, so pumps are also erected to pump it off wherever the drainage is so bad that it does not run off easily by itself.

The fellaheen also use an ingenious native contrivance for either watering or draining their fields—a long wooden cylinder with a wooden spiral inside—and placing one end in the canal and the other end raised on the field two men turning a handle create an astonishing flow of water.

There may be many difficulties in Ceylon of introducing drains, such as lack of gradient, especially near the coast where the land is very little raised above the sea-level, and the numerous ownership of the small fields. But still there must be many fields near rivers and lakes where drains can be made to the benefit of the crop.

Thus let us take a common example of a small village paddy-valley of terraced fields. It will nearly always be found that the lower fields are water-logged and never dry off properly at harvest. The common practice is simply to let the water from the water-head flow down from field to field, where the main water-way is gradually formed down the centre of the fields. Now for proper regulation of water this is wrong and just the opposite should take place, a deep *drain* should flow down the centre, two small canals should be made on either side from the water-head and the water let on *across* the terraces to the drain, instead of *down* them. Thus each field can be easily filled, left for several days and then drained off by opening gaps in the central drain. Close these and re-fill the fields with fresh water and so on to harvest, when the fields can be dried off entirely. *The sketch will explain more clearly.* Golden rules to be observed in making the water-ways for paddy-fields are—

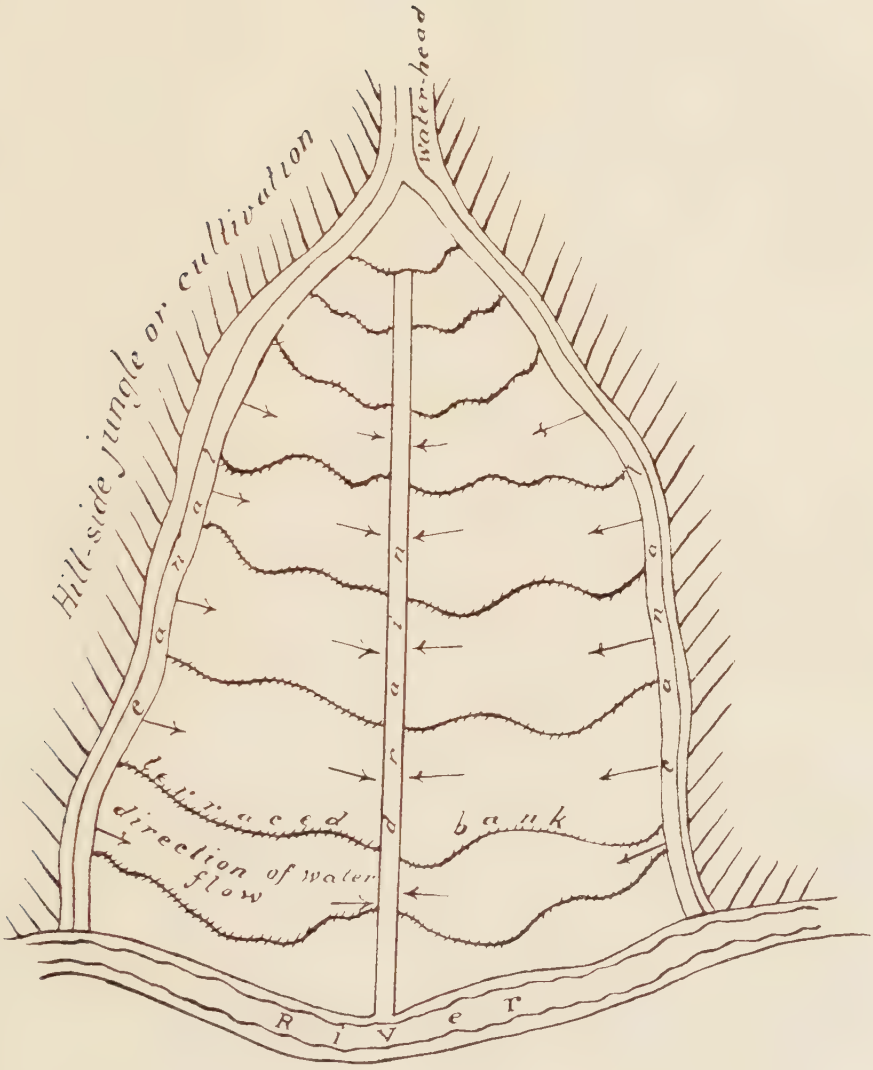
Drains in the lowest parts.
Canals in the highest.
Never use a drain as a canal:
And keep your drains clean and deep.

Now I should like to lay stress on a few further facts with regard to paddy cultivation well within the reach of every native cultivator.

In Egypt only ½ a bushel is sown per acre and the yield is between 60—150 bushels per acre. In Ceylon two bushels are sown and 40 or 50 is the average reaped from the best fields. The soil of Ceylon may not be quite so rich as that of Egypt, but the water supply is more certain. In many cases where labour is scarce and dear, the goiya finds it more expedient to sow thicker so that the weeds may be smothered and the expense of weeding thus avoided, though he loses on the resulting crop. But if the land has been thoroughly prepared in the first place, the weeds coming up as a result of thinner sowing should not be serious, and one weeding should be sufficient and the resulting crop pay a good profit.

The Egyptian fellah has learnt two great and important factors in his cultivation, namely, that of dry-ploughing and manuring.

With regard to the first, soil, and especially that which has been subject to much water, *must* have air and sun let into it to sweeten it, whereby the air oxidises certain compounds and renders them fit for plant-food, without which no plant can thrive. Therefore, directly the crop is off and whilst the land is still soft, the soil should be ploughed and left as long as possible for sun and air thoroughly to do its work. Water may then be let on, and the land prepared in the ordinary way.



Plan of watering & draining
Paddy-fields

And now as regards manuring. We know that the more manure in reason you can give your soil, the higher will be the yield of the crop. Cattle-manure, which is the best of all, is scarce and difficult to get, and artificial manure is generally beyond the means of the native cultivator, unless he belongs to a Co-operative Credit Society. What then remains ? Well, there is green-manure, and this is within the reach of every native cultivator at very little cost and labour.

In Egypt the common practice is to sow berseem (a variety of clover) in the standing paddy as soon as the water is finally drawn off the crop, 10 days before harvest. The seed falling on the soft mud germinates at once and by the time the land is dry enough to harvest the paddy, the clover is one or two inches high and will not be hurt by being trampled on. It soon springs up above the stubble and requires irrigating once or twice before it is fit to cut, in six weeks' time from sowing. In Egypt this clover lasts three months and is cut three or four times, forming an invaluable fodder for horses and cattle. Then it is ploughed in green, giving to the soil rich nitrogenous manure stored in root and leaf. Thus in one operation is the soil manured and given air and sun. The Egyptian in consequence reaps his hundredfold. Unfortunately this invaluable clover does not thrive in Ceylon, but there are many green-manures which will do just as well. There is *Tephrosia purpurea* (pila) which grows wild in the Northern Provinces and which makes a good, nitrogenous green-manure. Sown broadcast, it can be ploughed in after two months' growth when it is about two feet high. Sunn Hemp (Sin. *Hana*) grows easily and Dhaincha (*Sesbania aculeata*) is also recommended.

There is also the creeping lima bean (*Phaseolus lunatus*) which grows easily and forms a thick cover and would be ready for ploughing in before next sowing season. All of these have the advantage that straying cattle will not eat them, so that fencing is unnecessary. Other crops that will act as green-manure, and at the same time yield a partial crop for human consumption, are various grams, cow-peas, groundnuts, etc, ; but these necessitate ploughing in before the whole crop is harvested and whilst the leaves are still green, and also require more frequent irrigation and fencing against the depredations of cattle.

There remains one more important factor, and that is seed-selection. Before harvesting his crop the cultivator should walk all round his field and cut all the paddy which shows the heaviest grain and the largest number of stalks from one root. This he must lay aside in sheaves to be threshed out separately and, finally, carefully store away for future seed. It is only from the *best* seed that the biggest yield can be expected. In Ceylon these important factors in good paddy cultivation are only just beginning to be recognised, through the efforts of the Ceylon Agricultural Society and the Co-operative Credit Societies, who can procure both manure and good seed-paddy on easy terms. Six Societies have bought 25 tons of manure this year.

I may here point out that travelling through the Peninsula of Jaffna, one is struck by the stretches of fine paddy looking in first-class condition. And this paddy relies almost solely on rain ; therefore the crop is grown on only a *limited* supply of water.

Secondly the common practice in Jaffna is both to use green-manure and to plough so that the sun and air can get into the soil.

To summarise :—

1. Plough the soil for sun and air.
2. Grow green-manure and plough it in to enrich the soil, or apply a dressing of artificial manure.
3. Sow only the best, selected seed and only ½ a bushel per acre.
4. Allow less water on the land to secure good roots and strong plants.
5. And, finally, provide drains where possible to carry off the surplus water where there is no natural drainage.

RICE CULTIVATION.

As an encouragement to paddy cultivators in the neighbourhood of Kandy two medals were offered for competition in Kulugammane Siyapattu and Udugampaha in Harispattu, to be awarded to the cultivators who worked their fields in the most approved manner and secured the highest yields. Great pains were taken in the preparation of the fields, the manuring of the land and the care of nurseries. In all 28 cultivators competed—12 in Kulugammane and 16 in Udagampaha. The two tracts of fields being of different character were judged separately. Before the harvest 8 fields were rejected in the first tract and an equal number in the second, owing to bad drainage, neglect to weed, etc. At the final judging of the 1st tract 4 selected fields were carefully examined and a final selection made. In the 2nd tract out of the selected 8 fields 2 were reckoned as equally good, but at the harvest it was found that the yield of one was greater by 5 bushels per acre. MR. MOLEGODE, assisted by MR. NUGAWELA, organised and supervised the competition. The highest yield in the first tract was 55 bushels per acre and in the second 64 bushels per acre. A similar competition has been organised for Uduwela and Paningamuwa villages near Kandy and Peradeniya respectively.

Some anxiety was experienced early in the year over the appearance of a *paddy pest* in the Kandy district. MR. MOLEGODE was deputed to report on the infected areas, which were subsequently inspected by the Secretary. Though of tolerably wide range the total damage was not extensive. Specimens of insects and damaged paddy were submitted to the Government Entomologist, who reported that the pest was not a new one, MR. E. E. GREEN having received specimens in 1900 and 1911. LEFROY on page 32 of his "Indian Insects" refers to the damage done by this insect for which, he states, no effective remedy has been found. The only method of dealing with the pest is, as far as possible, to collect and burn the affected stems. The insect is known to entomologists as *Acalyptrate Muscoides*, popularly, as the "rice stem fly," and in Sinhalese as "Purukpanuwa." The larvæ live in the young stems and pupate there, mature stems being rarely or never attacked. The wilted stems are easily pulled out from the ensheathing leaves.

MR. K. B. BEDDEWELA, writing about *Dr. Lock's paddy*, states that the first crop when turned into rice was found to be more or less "watery" and could not be kept long after boiling. This has been attributed by some to the application of artificial manure. The rice from the second crop is said to be better than the first. The manure mixture used on the crop consisted of 100 lb. half broken coral, 100 lb.. $\frac{1}{4}$ to $\frac{1}{2}$ inch bones, 25 lb. Sulphate of Ammonia, 25 lb. Nitrate of Soda, and 25 lb. Sulphate of potash, or 275 lb. in all, costing about Rs. 15·25 per acre.

Last Maha season 15 acres were cultivated about Kandy with this paddy and seed is now available to members.

Arrangements are being made to test the Japanese method of *seed selection* by immersing the seed in a solution of common salt so that the heavy seed may be separated from light, on the assumption that it is better to sow heavy seed than light. The light seed floats on the surface while the heavy seed sinks to the bottom. Seed selected in this way and sown less thickly has been found to give a larger outturn per acre than unselected seed.

The cultivation of *Muthusamba Paddy* is being taken up in Hewaheta, Udapalata and Udunuwera. The local rice is considered superior to that imported from India.

Some *Upland Paddy* seed was procured from Queensland and distributed among a few selected growers. MR. BEDDEWELA reports that it grows with less than the ordinary allowance of water and should suit fields that get a scanty supply. MR. PROCTOR recognised the seed as similar to a variety grown in Demalhatpattu in N. W. P. and enquiries were made of HULUGALLE ADIGAR, the late R.M., who kindly forwarded samples, reporting that the paddy was introduced about 12 years ago and is fairly extensively cultivated in that district where it has become popular.

The single seedling of *Perennial Rice* raised by MR. BEDDEWELA is just now in ear, and it is hoped to secure some seed to propagate this interesting plant. MR. K. B. BEDDEWELA, writing on April 27th, says, "I am sending you some ears taken off the perennial paddy plant. You will observe that the seed has not set, which is disappointing. I have since cut down the plant and new shoots have already appeared which I am hoping will produce some good seed."

MR. C. D. A. GUNAWARDENA forwards a report on the cultivation of *Yahaing* and *Shangale* paddy from Burma. These varieties are known to be water-resisting and were cultivated on fields apt to be flooded. Yahaing withstood inundation when the ears were ripening. The paddy is a three months variety and was broadcasted on 17th November. It went under water from 27th November to 1st December, 6-9 December, 1-5 January, and 16-18 February. The yield secured was 45 bushels per acre. Shangale failed to germinate satisfactorily.

MR. MOLEGODE carried out a transplanting trial in Galasiyapattu with the following results:—An acre of land transplanted with lots of 3 seedlings 6 inches apart gave a yield of 52 bushels grain while the ordinary yield

per acre in the same range of fields was between 35-40 bushels. This is the third year that the advantage of transplanting has been demonstrated in this Korale and an extent of over 30 acres will be cultivated on the same lines this season.

The following are the results of a transplanting experiment conducted by MR. J. R. NUGAWELA, Agricultural Instructor, at Nugawela. Variety of paddy:—Hatiel, 7 months. Date sown 29th July, 1914; transplanted 8th September, 1914; cropped 1st March, 1915.

Size of each plot.	No. of Seedings per hole.	Yield per plot.		Yield per acre.		Bushels grain per acre.
		Grain lb.	Straw lb.	Grain lb.	Straw lb.	
	1	51	98	1530	2940	34
36 × 40 ft,	2	84	156	2520	4680	36
=1440 sq. ft.	3	95	185	2850	5450	63⅓
=1/30 acre.	4	80	170	2400	5100	53⅓
	5	68	138	2040	4140	43½

The following are the results of trials made at Godagandeniya near Peradeniya:—

(a) Molagusamba sown 25th September, 1914. Harvested 8th March, 1915. Yield 84 bushels per acre.

(b) Madael sown 26th October, 1914. Harvested 8th March, 1915. Yield per acre 56 bushels.

(c) Half an acre was planted with seedlings raised from 1 bushel of *Dr. Lock's* paddy and yielded 90 bushels per acre.

The results of a transplanting experiment published in the report of the Department of Agriculture, Burma, are of an interesting nature. They prove that it is a mistake to transplant paddy at too great distances and are in favour of an average of 4-6 in. unless seed of a great tillering power is utilised. It is thought that the most economical method of transplanting is to plant single seedlings at distances of 4-6 in.—C. A. S. PROGRESS REPORT

TRANSPLANTING RICE.

BERNARD COVENTRY.

Madras continues to make steady progress in the popularization of the method of single seedling transplantation which is so obviously reducing the seed rate and improving the yield that its general adoption will only be a matter of time. In Godavari, Tanjore and other Southern districts, the usual seed rate was about 100 to 150 lb. per acre and bunches of from 5 to 8 and even 16 plants were transplanted. By single seedling transplantation the rate was reduced to 20 lb. resulting in a saving of about Rs. 3 an acre in seed

alone without affecting the outturn. The system has been very widely taken up in Tanjore and other Southern districts and it is estimated that the profit arising therefrom must be worth about 10 lakhs of rupees a year. Taking into consideration the area of 10 million acres of paddy in the Presidency, of which more than $\frac{1}{3}$ is transplanted, it will appear that there is still much to be done in this direction. In Mysore and Travancore the popularization of single seedling transplantation and growing of Banku paddy introduced from the Central Provinces is meeting with equal success.

As usual the popular methods for disseminating information adopted in the Central Provinces have resulted in a grand total of 30,000 acres being put under transplantation in the year under report, and it looks as if in the future this work may have to wait on the exigencies of the Irrigation Department as soon like ALEXANDER and it will have no more "irrigated" lands to conquer.

The material advantage is shown by the fact that taking the value of the increased yield of a transplanted crop at the low figure of Rs. 15 per acre, this transplantation has resulted in an increased profit of some $4\frac{1}{2}$ lakhs to the cultivators concerned.

A party of 35 cultivators was taken over rice growing villages in Bhandara and Balaghat during the rains, a form of agricultural demonstration which is one of the finest methods of getting at the most ignorant and backward.

MANURING.

The experience so far gained appears to be in favour of green-manuring where paddy is transplanted and successful efforts are being made to spread the practice in various provinces. Castor cake or green leaf together with super-phosphate continues to show its superiority as a manure for paddy in Madras, the increased yields averaging about 700 lb. of grain per acre. In Travancore and Mysore oil cakes and bone meal seem to produce the largest yield and their use is being widely demonstrated. In Travancore calcium cyanamide is also recommended as the best nitrogenous fertilizer, while in Assam the use of bone meal is being demonstrated with favourable results but in the case of such a manure it is essential to wait until after the third season. It is interesting in view of the above differences to note that the Board of Agriculture in 1913 appointed the committee with a view to examining the work already done and to working out a scheme for further investigations on the subject of paddy, suggested among other things, that as the crop is cultivated under vastly different conditions in the various provinces, each province must work out for itself the problems connected with cultivation and the methods of cultivation.

On the chemical side, MR. HARRISON in Madras continued his investigations into the conditions affecting the cultivation of paddy under swamp conditions. The results which throw considerable light on some of the factors essential for the maximum growth and yield of paddy have been published in the CHEMICAL MEMOIR, Vol. IV, No. 1. Enquiries on useful and practical lines have also been started in Burma and Bengal dealing with manuring, early ripening and other important factors affecting the yield and quality of the grain.—REPORT ON THE PROGRESS OF AGRICULTURE IN INDIA, 1913—14.

RICE HULLERS.

At the instance of certain members the Society has made enquiries from India and Europe about *hullers* suitable for dealing with rice. From these enquiries it would appear that the most efficient machinery for the purpose is that of the Engelberg type. MR. PATIL, Extra Deputy Director of Agriculture, Bombay Presidency, has kindly forwarded the following particulars furnished by MESSRS. MARSHALL & SONS, Bombay, regarding the machine :—"If the machine is required for commercial purposes, to give the best results, what we would advise is that a Power Driven Engelberg Rice Huller and Polisher be installed. A plant of this description could be relied upon to give a large output of rice, ready for the market. We might mention that there are probably over 2,000 Engelberg Rice Hullers working all over India, giving most satisfactory results."

We quote you below for the smallest Power Driven Plant we can offer, viz :

1. *One Engelberg Rice Huller and Polisher Combined*, size No. 7, approximate capacity 30 Bags (each of 175 lb.) of white polished rice direct from paddy, per day of 12 hours		Rs. 600
1. *One "Blackstone" Oil Engine, Type "H. S." Mark "C. W. C."* of 13 continuous working Brake Horse Power ; with Independent Oil Tank for driving the above machine ; Complete with two Flywheels, Exhaust Box, and standard outfit	Rs. 1,825	
Extra for a set of Foundation Bolts for above ...	,, 10	
Extra for water vessels	,, 160	
Extra for connections up to 5 ft. between water vessels and Oil Engine	Rs. 55	
Extra for exhaust Piping up to 15 feet ...	,, 45	
Extra for a Standard Driving pulley ...	,, 55	
1. *One suitable Driving Belt* for conveying Power direct from Oil Engine to Rice Huller with suitable belt fasteners	Rs. 60	Rs. 2,210
	Total	Rs. 2,810
	Less 10% discount	Rs. 281
Nett Cost, packed where necessary and delivered Free on Rail, Bombay		Rs. 2,529

Writing direct MESSRS. MARSHALL & SONS, quote Rs. 625/- less 5% delivered on rail Madras for a huller capable of an output of 50 to 60 bags of

paddy (175 lb.) and add that the machine is fully guaranteed to give the best results obtainable, the wearing parts being made of English chilled iron and hard crucible cast steel. If required without a polisher the cost is Rs. 475/- less 5% delivered Madras. It should be mentioned that the ENGELBERG Co. is an American firm, whose agent called here last year.—C. A. S. PROGRESS REPORT.

SOWING RATE FOR RICE.

With regard to the question of *reducing the seed rate* in broadcasting, the following communication from the Deputy Director of Agriculture, Madras, is much to the point :—" I have the honour to inform you that anything from 20—40 Madras measures of paddy (1 to 2 bushels) may be sown per acre for broadcasting paddy. The exact quantity depends on—(1) The duration of the crop. Short duration crops require a heavier seed rate than long duration crops, as they have not time to tiller so freely. (2) The method of sowing. Germination is naturally more complete when the seed is sown on a puddled surface than when sown dry, and again it is more complete when sown dry on a properly prepared seed bed than when merely ploughed in.

The question, therefore, whether the seed rate can be reduced largely depends on whether the farming practice can be improved. Apart from this, however, a trial was made at Palur some years ago by reducing the local seed rate of 22 Madras measures for broad casted Sornavari by half, i.e. 11 Madras measures per acre, and it was found that the yields were practically the same. Here again this result was probably influenced by the care bestowed on cultivation. The seed was sown on a puddled seed bed which was carefully levelled. Ryots also sow on a puddled seed bed, but as a rule are not so careful in levelling the field. Thus blanks occur in low lying places which were subsequently filled up by transplanting seedlings obtained from parts of the field where the crop is too thick."—C. A. S. PROGRESS REPORT.

SUNN HEMP AS GREEN MANURE.

The following are some of the results of trials in green-manuring paddy. It is proposed to continue these, and it will not be till the next crop that detailed results will be available. Directly the paddy crop has been taken in sunn-hemp seed should be sown, and after six weeks, or at the time the sunn-hemp is flowering, the crop should be cut and ploughed in. Sufficient time say 2 months, should elapse between the ploughing in and the

sowing of paddy so that the green stuff may be thoroughly decomposed and incorporated with the soil.

Name of Instructor.	Centres	Extent.	Yield.		Calculated yield per acre.	
			Ordinary.	Manured.	Ordinary.	Manured.
W. Molegode	Uduwawela	½ acre	20	28	40	56
do	Dunuwila	do	24	30½	48	61
do	Molegode	do	18	26	36	52
L. A. D. Silva	Ratnapura	¾ acre	27	39	26	52
M. J. A. Karunanayake	Tissa	1 do	16	24	16	24
J. R. Nugawela	Nugawela	2 do	60	74	30	37
do	do	½ do	18	24	36	48
do	Matale	3 do	86	90	28	30

—C. A. S. PROGRESS REPORT.

THE OIL TRADE.

In an interview which MR. HAROLD BROWN, Superintendent of the Scientific and Technical Department of the Imperial Institute, has granted to a representative of the CHEMIST AND DRUGGIST some interesting facts are revealed. With reference to the oil-trade we are told that there is plenty of evidence to show that had not the War intervened, Germany, by her methods of undermining British firms, would in probably less than 5 years have acquired practically all the business in oil-seeds. For several years past she has been the world's largest consumer of copra, a position formerly held by France. In 1912-13 she took some 196,000 tons, and the United Kingdom 30,000 tons only. The curious part is that most if not all this copra has been worked up in Germany into oil for the British market. During 1913-14 Great Britain took from Germany £1,377,000 worth of oil mostly made from copra exported from Ceylon and India.

As regards ground-nuts there is the same tale to tell. The imports of this product into Europe exceeded 11 million tons annually valued at £6,000,000. Before the war France, Germany and Holland were the most important crushers. In 1912 France took 9,500,000 cwt. valued at £6,597,000 ; Germany 1,930,000 cwt. worth £1,318,000 ; while the United Kingdom's imports were considered too small to be classified separately. And yet the British Empire furnishes over 7 million cwt. of the nuts annually. The position in India is now rendered acute owing to the shutting-out of exports to Germany, and France not being able to take her normal supplies.

SUGAR CANE.

MANURING CANE.

J. B. HARRISON, C. K. BANCROFT, AND R. WARD.

In a study of the effect of manures, the mean returns on 39 varieties as ratoon canes with normal and high manurings, 300 lb. and 450 lb. of sulphate of ammonia per acre respectively, were 19 and 22·5 tons per acre respectively, as compared with 11·1 tons from the untreated area. Sulphate of ammonia is noted as a better source of nitrogen than nitrate of lime, nitrolim, or nitrate of soda, the mean annual increases for four years by the use of 50 lb. of nitrogen in the various forms being 9·4, 6·7, 5·9, and 4 tons of cane per acre over the untreated area. The use of dried blood is noted as being far from satisfactory.

It is shown that in normal seasons the addition to sulphate of ammonia of sulphate of potash and superphosphates of lime actually reduced the yield. The addition of phosphates to nitrogen fertilizers produced increased yields, but these increases were not remunerative. Molassses in 100—, 200—, and 300—lb. rates has given negative results with cane. (E. S. R., 30, p. 822). No advantage was shown by the partial sterilization of the soil by the application of chlorinated lime, yields being lower this year on the treated plants.

—EXPERIMENT STATION RECORD.

BRITISH COLONIAL SUGAR.

There has been a good deal said and written as to the desirability of the cultivation of beet-sugar being taken up in England, but it would appear that the farmers are not very enthusiastic about it. THE WEST INDIA COMMITTEE CIRCULAR advocates the extension of cane cultivation in the West Indies, and quotes PROFESSOR. HARRISON, the Director of Agriculture in British Guiana, as its authority for the statement that if the extensive tracts of virgin land still available in that colony are opened up a total output of 2½ million tons of sugar per annum could be counted upon from British Guiana, or about half a million tons more than is normally required by the United Kingdom.

We also read of the possible expansion of the sugar industry in Fiji. There are at present under sugar in this colony (or was in 1913) 48,208 acres which produce 94,709 tons per annum.

Two large possible schemes, covering about 19,500 acres, should, on the above basis, be capable of adding another 38,000 tons per annum to the output, while it might be feasible to exploit, under smaller schemes, an additional 20,000 acres and secure a further output of 39,291 tons per annum.

With the aid of the colonial possessions it is not unlikely that British enterprise will more than meet the requirement of the empire, which to a great extent depended upon foreign-grown beet sugar.

FIBRES.

THE IDEAL COTTON PLANT.

H. MARTIN LEAKE.

Broadly speaking, the degrees in quality are determined by the fineness of the thread that can be spun, though here again we have to distinguish between two types of thread—the warp and the weft. For the production of a fine thread certain essentials are necessary. In the first place, we may cite length, for, the longer the individual fibre, the less will be the chance of several ends occurring at a particular spot in the thread and of the formation of a point of weakness where breakage of the thread is likely to occur. Length of fibre will help to an even distribution of strain. For a thread to break, however, it is not necessary that the individual fibres should rupture. Rupture of a thread probably is rarely initiated in this way. Most frequently it results from the drawing apart of interlocking fibres. In other words, the strength of a thread at any point is not given by the sum of the breaking strains of the individual fibres of which it is composed at that point ; it is considerably less than this figure. Two points emerge from this consideration. The first of these is the nature of the force which binds the fibres together. The process of spinning consists firstly of rendering the fibres parallel and then twisting them to form a thread. The retention of that twist, however, is due largely to the natural twist of each individual fibre, which causes these to interlock—such natural twist is, therefore, a matter of the utmost importance. Secondly, it is clear that the larger the number of the interlocking fibres, the greater will be the force required to pull them apart, or, given the diameter of the thread, its strength at any point will, within limits, increase with the number of fibres of which it is composed at that point. Fineness of fibre is, therefore, a point of much importance.

The three main qualities which, from the consumer's aspect, have to be taken into account are :—

1. Length of fibre,
2. Twist of fibre,
3. Fineness of fibre.

Further points, from the spinner's point of view, are of importance, though this importance is secondary from the aspect of the plant breeder. Here only three may be mentioned :—

Colour,
Uniformity,
Nep.

Our ideal plant may, therefore, be defined as one which possesses as its more important characters, an early maturing habit; a profusion of large bolls; a high ginning percent; a long, fine, uniform fibre possessing a good natural twist: a good colour and freedom from nep. The production of such a plant, or plants, is the ultimate aim of the work which has now been in progress for some years and an attempt will here be made to show not only

the degree of success which has been obtained in approaching this ideal, but also the evidence there is that such a plant is obtainable—for it is conceivable that some pair of these desirable characters might be mutually exclusive. What is meant by two characters being mutually exclusive can best be illustrated by a reference to the generally accepted idea that length of staple in some way is associated with the growing period of the plant. This idea has found tentative expression in a recent publication* where the following remark occurs: "Length of staple appears to be connected in some way with length of growing season—at any rate no long-stapled cotton has yet come into general cultivation in any district where the normal development of the plant is interfered with by cold at one end of the season and excessive heat and drought at the other. It is probable, however, that this is a coincidence, and that it may eventually be possible to combine earliness and length of staple with a fine yielding power in one plant." In this connection we have first to consider what is meant by the terms "long" and "short" staple. At one extreme of the cottons of commerce lies the Sea Island Cotton with a staple of over 2 in.; at the other lie the inferior Bengals, with a staple of about ½ inch. Between these extremes lie a number of forms, giving an almost complete gradation, and the delimination of short and long-stapled forms becomes largely a matter of personal choice for which no hard-and-fast definition exists. Practically, however, such a delimination can be given. Reference has been made to the Lancashire markets as long staple and to the Continental and Eastern markets as short. Broadly speaking, this distinction holds and the question, therefore, resolves itself into one of the possibility of producing an early maturing plant having a staple at least equal to middling Americans, which we may accept as the standard of the Lancashire market. The answer to this, and similar questions as to linkage between different characters, will be given later, after fuller information concerning the characters concerned has been acquired.

HABIT.

As has been stated above, the ideal plant must be early maturing, or the yield will be low. The dependence of the length of the vegetative period on the type of branching has, on so many previous occasions, been indicated that this point need not be laboured here. Briefly, the main stem of the cotton plant produces two types of branches—the vegetative and the reproductive. The initial branches, those nearest the ground, are almost invariably vegetative while, higher up the stem, this type of branching may give place to reproductive branches. Clearly, the sooner such replacement takes place, the earlier will the plant begin to bear flowers. The type of branching is a point of primary importance in the consideration of habit. Unfortunately, for simplicity's sake, it is not the only point. Certain types of plant occur in which only a small number of vegetative branches arise at the base; above these, branches of the reproductive type are produced but these remain small, and, if buds are produced on them, these buds do not develop into mature fruits. The vigour of the plant is absorbed by the main stem and the few vegetative branches which become long and woody. Such a type cannot produce a commercial crop, and we have to take into consideration a second point, namely, the direction in which the vigour of the plant is diverted. The ideal habit for a plant is one in which the lower branches are vegetative and of moderate growth, while the upper are reproductive and vigorous.

* REPORT ON THE PROGRESS OF AGRICULTURE IN INDIA, 1912-13.

GINNING PERCENT.

The ginning percent of the cottons under general cultivation varies from 30-33, and this figure may be accepted as the standard in considering the question of improvement. During the past few years DR. PARR has isolated a type of cotton, whose cultivation has spread rapidly in the western districts of these provinces, of which the ginning percent is 40-41, and for the *kapas* of this the cultivator receives a relatively enhanced price, a fact which has to be taken into consideration in deciding whether a new form is a sufficient improvement to justify introduction to the public. The direct relation existing between the ginning percent and the price realized by the cultivator for his *kapas* lends additional import to this figure, and the question of ginning percent has received on this account much detailed attention. The problem is no simple one, but sufficient has been learnt to render it probable that the production of a plant showing a high figure for the ginning percent will no longer be the purely speculative matter it has hitherto been. It is not possible to go into details here; those that desire fuller information on this subject may refer to the present writer's paper dealing with this point.* Briefly, it has been shown that the ginning percent depends mainly on the number of the fibres arising from a single seed and, to a less degree, on the size of the seed and weight of the individual fibres. With this knowledge it is hoped to produce, by suitable combinations, plants with a ginning percent much above the present standard.

SIZE OF BOLL.

The size of the boll is very variable, as the following figures for the weight of the *kapas* from individual bolls indicate. At one extreme lie the types with a *kapas* weight of 2 g. or less: Broach, *nurma* cottons and others. At the other extreme lies *G. cernuum*—the Garo Hill cotton—with a *kapas* weight as much as 5 g. Between these extremes lie the common cotton of cultivation with a *kapas* weight of 2·5 g. to 3 g. Clearly here there is a range sufficient to make a large difference to the crop yield, supposing the number of bolls to remain constant. The size of the boll is, in a large measure, determined by the number of seeds, the smaller bolls having 7 to 8 per cell—21-24 in all, the medium 8-10, and the largest, those of *G. cernuum* 13 to 15. It must not, however, be thought possible to double the size of the boll without influencing in some measure their number. The physiological processes of the plant set a definite limit to the production of the food material necessary to nourish the developing embryos, a fact which receives practical demonstration in the length of the fruiting season. With the production of the maximum number of bolls the plant is capable of developing, flowering ceases; consequently the large bolled-forms have a comparatively short season. Nevertheless, it appears probable that reduction in number is not strictly proportional to the increase in size of the fruits, and that considerable advantage will arise from increasing the size of boll not only through the direct increase in yield but in the number of pickings and in the ease of picking a few large, as compared with many small, aggregates.

LENGTH OF FIBRE.

The determination of this character is a matter of considerable difficulty. The cotton buyer has evolved a practical method which is most

* JOURNAL OF GENETICS, IV (1914) p. 41

efficient in answering his purpose. It is not, however, suited to the plant breeder who has to take into account the differences between plant and plant. The cotton plant produces fibres throughout a considerable period, 2-3 months, and under most diverse conditions. As the season proceeds, the moist and hot conditions change to dry and cold. It is not surprising, therefore, that considerable differences in length of fibre are found in samples gathered from a single plant at different seasons. It is further demonstrable that the fibre length varies not only from seed to seed in the boll but even from different parts of the same seed.* For the purposes of plant breeding measurements must be comparative and the samples, therefore, must be taken so as to eliminate such variations as far as possible.

Such guarded determinations show that the length of fibre of Indian cottons varies from 12 mm. to 30 mm. or over.†

Of the former length are some of the poorest forms of Bengal cottons. The latter length is approached only in such cottons as Broach, *nurma* and *bani*. Much of the American type of cotton has a staple ranging from 25 mm. to 30 mm., so that among the Indian cottons we have the range of fibre length necessary to produce a long staple cotton.

TWIST OF FIBRE.

During the ripening process, after the fruit has opened, the individual fibres lose their moisture, take on a more or less flattened form and become irregularly twisted on their axis in a spiral manner. It is this twist which causes the fibre to grip the thread. As far as the writer has been able to observe, none of the cottons with which we are concerned suffer from lack of twist—probably the danger lies rather in the presence of an excess.

FINENESS OF FIBRE.

A large range of variation in this character is found in the Indian cottons, and here, again, the chief difficulty has been met in obtaining a practical method for measuring "fineness." The common methods of direct measurement of breadth are unsatisfactory for the fibre is not, in the first place, round, and in the second place, sufficient determinations to obtain a true average would be beyond practical possibility. The figures adopted here indicate the area of cross section of 1,000 fibres. The range of fineness thus determined has been found to vary from 0·5. sq. mm., in the case of coarse Bengals, to 0·13 sq. mm. in the case of *bani* cotton. The latter figure is the same as that found for Upland American cotton, while a sample of Egyptian cotton alone, of those tested, proved to be finer, with a figure of 0·12 sq. mm. Thus we have, among the Indian cottons, races which equal the fineness of the Upland American.

COLOUR.

There is no better way, in dealing with this somewhat elusive character than to quote the words of MR. MCCONNELL.‡ "But for the most part colour is chiefly important as the index to quality. The buyer of cotton yarns is suspicious of the quality if the colour is changed, but when once he is

* Yves Henri. *Determination de la valeur commerciale des fibres du cotton.*

† A mm. standard here is purposely adopted in preference to an inch standard. The measurements are comparative only, and it does not necessarily follow that 25 mm. (1 in.) fibre length would give a sample which commercial determination would denote as of 1 in. staple.

‡ TEXTILE MERCURY, March 21st, 1914.

satisfied that the quality is right, a new shade, whether lighter or darker generally becomes as acceptable as the old."

From this it would appear that, though price is undoubtedly paid for colour,* it is rather as an indicator of quality than for its intrinsic merit. Being a character that is with difficulty determinable except in bulk samples, it is not possible to breed for colour. Practically, however, little difficulty has been incurred in maintaining a good colour.

UNIFORMITY OR THE EVENNESS OF STAPLE LENGTH.

Lack of uniformity, as it is understood commercially, is most commonly due to race mixture in the field. Such lack of uniformity is at once removed by the cultivation of pure races. Such evidence as we have seems to indicate that the unifomity of a pure race is far in advance of that found in any commercial sample. When it has been detected in our samples it appears to be due to the admixture of successive pickings which the comparatively small areas, and the desire for a bulk sample, rendered necessary. Grown on the commercial scale when the successive pickings would be harvested separately, this cause of lack of uniformity will, in all probability, be found to disappear.

"NEP," "REFRACTION," Etc.

Under such terms are included all losses in the process of spinning represented by the difference between the weight of cotton taken and the weight of yarn obtained. Such losses occur at different stages and have a different origin. In the blow room the chief loss is due to the removal of dirt and extraneous matter such as leaf. The extent of loss will depend very largely on the care expended in picking, but to a certain degree on the extent to which the boll opens and exposes the cotton. In this character the Indian cottons differ considerably.

The second loss is in the carding process, during which the weak, short and immature fibres are largely removed. There appears to be no evidence to connect this loss with the character of the plant. It is, rather, traceable to external conditions such as poor cultivation, unfavourable climatic conditions, leading to disease, and such causes. As such, it has little bearing on the plant breeding aspect of the question.—AGRICULTURAL JOURNAL OF INDIA.

COTTON IN CEYLON.

Allen's long staple cotton at Ambalantota and Hettipola is bolling, and, in view of the closing down of the Agency for the sale of cotton, arrangements are being made to sell the produce on the spot. The local price compares favourably with that offered in Colombo, considering that cost of transport is saved.

The Manager of the Experiment Station, Peradeniya, reports as follows on a sample of *Allen's Long Staple Cotton* from the Ambalantota Garden :—Grade, good and even; Quarters, long and full ; Quality, fine and silky; Length of staple, good; Strength, fair. If this is a sample of the bulk it would pass as first class.

* LEAKE and PARR. AGRICULTURAL JOURNAL OF INDIA, VIII (1913) p. 47.

Cauto Cotton, to which the Society is giving a trial, is still another variety, thus referred to in the KEW BULLETIN : "A fine series of specimens of "Cauto" Cotton has been received from MR. HARRIS, Superintendent of Public Gardens and Plantations, Jamaica, who writes :—"This is said to be a "tree cotton" I suppose a large shrub really, and is apparently found in a wild or semi-wild state in the Cauto district of South Eastern Cuba. Our plants are only 6 months old from seed. and have not yet attained their full dimensions, but they are now bushes up to 10 feet high. The plant is a perennial, and, according to our information, is likely to prove of considerable agricultural value for cultivation in dry districts in the tropics. We have about 2 acres at Hope, and there are a good many acres at present under trial in various parts of the arid Southern districts. We are now passing through a very severe drought, having had scarcely any rain since the beginning of last December, and yet the cotton bushes are in excellent condition and producing crops estimated to yield at least 1,200 lb. of seed cotton per acre, and as this cotton has been sold at prices varying from 18 to 20 cents per lb. in the American Markets, you will see that it is a plant of much promise for lands that are now producing nothing but scrub. The specimens sent agree in most of their technical characters with *Gossypium brasiliense*, Mach., from which they differ, however, in the seeds being free from one another. In view of the statement that Cauto Cotton is wild or semi-wild in south-eastern Cuba, it may possibly represent the wild stock of *G. brasiliense;* and having regard to its close agreement with that species, apart from the free seeds, it has been provisionally named *Gossypium brasiliense* var *apospermum*, Sprague (var. nov.) as it seems desirable to have a definite name for such an important economic plant. At the same time the possibility of its being a hybrid of *G. brasiliense* with some other species cannot be entirely excluded."

The question has arisen as to what should be done with the ginning plant belonging to the British Cotton Growing Association which MESSRS. FREUDENBERG & CO. as the local agents had installed at their Kotahena Mills. In view of the present crisis and the slow development of cotton cultivation, the Association has decided not to appoint other agents, and suggests that the Agricultural Department should take over the machinery. The matter is still under consideration.—C. A. S. PROGRESS REPORT.

JUTE.

R. S. FINLOW.

Jute has been cultivated in Bengal since very ancient times but the export of raw jute, which marks the commencement of the great development of the crop, is quite modern. Even as late as the end of the first quarter of the nineteenth century the export of raw jute from India amounted to only a few hundreds of maunds—say 30 tons. Difficulty was experienced at first with jute, as with most other new products, in finding a market for it, but the trade in the raw fibre gradually expanded, the development being greatly aided by the Crimean War, until at the present time jute has practically completely replaced all other fibres as a basis for the manufacture of gunnies. To-day the total produce of jute in Bengal amounts to something like 1,750,000 tons, grown on upwards of 3,000,000 acres.

For its growth jute requires a high temperature and also abundant moisture in the soil. It is, however, contrary to what is generally supposed, not a crop which requires the land to be submerged during the period of its growth. Very fine jute is grown on lands which never go under water: it is indeed only during the later stages that even the more resistant of the two commonly grown varieties is capable of withstanding heavy flooding without serious damage. It is a rapidly growing crop, commonly sown in April and reaped at the end of July or beginning of August, which may produce 20 tons of green matter per acre in about four months; and it is, therefore, no matter for surprise that cultivation which may be described as intensive gives the best results. Usually cow-dung or castor cake or similar general manures are the fertilizers which produce the best results, but in some tracts the land is acid and the Bengal Agricultural Department has shown that lime is capable of materially increasing the crop. Apart from preparation of the land and sowing of the seed the important operations in connection with the crop are:—

(a) Weeding and thinning.

(b) Cutting, steeping (i.e., immersion in water), and retting (rotting).

(c) Stripping the fibre from the retted stem, washing, and drying.

A well-grown crop may be 12 ft. high or even higher, and the yield of fibre may be from 30 maunds (over a ton) per acre in exceptional cases to 10 maunds or even less. The Government standard of 15 maunds (3 bales) per acre seems to be a fair approximation to an average yield for the whole tract.

The jute grown in Bengal has been carefully classified. There are two botanical varieties, viz:—

(a) *Corchorus olitorius* (long-fruited jute), locally known as "desi" or "tosha."

(b) *Corchorus capsularis* (round-fruited jute).

The former is more commonly cultivated in the districts round Calcutta; it is a heavy yielder, but its fibre is slightly coarser than that of *C. capsularis*; it does not thrive on lands which become deeply submerged, but its cultivation is on the increase on high land farther north.

C. capsularis forms the bulk of the jute crop, being practically the only kind grown over the whole of the great northern tracts of Purnea, Rungpore, Mymensingh, etc. If it reaches the height of about 5 ft. before the soil become submerged it will continue to thrive even though the water becomes several feet deep.

Included in each of the two species named above are numerous varieties, viz:—

(a) Red-stemmed and green-stemmed.

(b) Early and late.

(c) Tall and short.

Some kinds also yield better fibre than others. A very careful classification and comparison of all the races which could be found has been made, both as regards yield and quality of fibre, and pure line selections

were made in the light of the knowledge thus gained. Large quantities of pure seed of the best quality are now becoming available, and the Government of Bengal has already committed itself to the establishment of large seed-growing farms.

By careful cultivation and by using the best seed it is possible that an increase of the order of 15 to 20 per cent. in the yield of fibre is ultimately possible from the area at present actually under jute, but such a result will naturally take some years to achieve.

About one-half of the raw fibre produced is consumed in the Calcutta mills, the other half being distributed between the foreign manufacturing centres. The fibre intended for the Calcutta mills is often either packed in loose bundles (drums) of one maund each or bulked in three-maund bales. For export the five-maund bale is universal.

In 1910 there were 45 mills in Calcutta, working 677,000 spindles and 33,000 looms, and employing 204,000 hands. The total share capital, which is to a very large extent European, of these mills approximates to £10,000,000.

Statistical details with diagrams are given in the paper regarding the exports of raw and manufactured jute to various destinations.

The paper also deals with the pressing need of increasing the output of jute :—

(a) By improved method of cultivation.

(b) By extending its area.

(c) By increasing the production of fibres which can be used as substitutes for jute.

Adulteration and the deterioration of baled fibre known as "heart damage" also receive attention.—PROCEEDINGS OF THE THIRD INTERNATIONAL CONGRESS OF TROPICAL AGRICULTURE.

THE COMPLETE DIETARY OF PLANTS.

The GARDENERS' CHRONICLE, referring to this subject, says that though we know that plants require certain elements of mineral plant food such as phosphorus, sulphur, potassium, lime, magnesium and iron, we have yet to discover what others are necessary for their healthy development. Recent experiments conducted by M. MAZE with all possible precautions go to indicate that in the case of maize in addition to the above, manganese, zinc, silicon and cerium as well as boron, aluminium, fluorine and iodine are also found necessary. Traces of these latter occur in spring water, and when water, purified by repeated distillation, was used the complete development of the plants failed.

On general grounds, says the paper referred to, we may conclude that what holds good for maize may also be found applicable to other plants as well. It is a matter not merely of scientific interest but (what is more important) of economic importance that the complete dietary of the plant should be established.

COFFEE.

MANURING COFFEE.

BEMESTING VAN KOFFIELANDEN.

The manure most commonly used for coffee at S. Paulo consists of stable dung, previously limed and mixed with coffee hulls. When these materials are scarce, poudrette and guano are used. It may be assumed that a three-year-old coffee plant requires 3-4 gms. of lime, 1·2 gms. of magnesia, 6·3 of potash, 0·7 of phosphoric acid. The stable manure used contains in 1,000 parts by weight 3·3 of lime, 3 of magnesia, 0·2 of potash, 4 of phosphoric acid ; the hulls contain per 1,000 : 3·9 of lime, 1·7 of Magnesia, 20·7 of potash and 1·7 of phosphoric acid. The poudrette employed, in default of the preceding manures, contains 6 per cent. of nitrogen, 2 per cent. of phosphoric acid and 2 per cent. of potash; the guano used in the best farms contains 4·5 per cent. of nitrogen, 10·5 per cent. of phosphoric acid, and 4·5 per cent. of potash; their price delivered at Santos is respectively 7*s.* 6*d.* and 6*s.* 6*d.* per cwt. First of all 16 to 24 cwt. of lime per acre are spread between the rows, then half a shovelful of stable manure and 22 lb. of macerated coffee hulls to every four plants; in the case of new plantations only the lime is given.

AN EXPERIMENT WITH ARTIFICIALS ON COFFEE.

Opinions differ as to the advantage of using artificials for coffee. Nevertheless the writer has conducted for the last 8 years several experiments on chemical manuring in several plantations, in view of the fact that the question of manuring coffee is becoming more urgent on account of the insufficient quantities of stable manure produced, which allow of its being used only once in 10 to 20 years. The following results were obtained in a plantation 50 years old which was completely impoverished. The experiment was begun in 1910; in the manured plot each plant was given 1·2 lb. of a mixed fertilizer containing 75 gms. of potash, 52 gms.of phosphoric acid and 28 gms. of nitrogen; the unmanured plot was given a single dressing in 1912 of stable manure with coffee hulls.

YIELD OF 960 COFFEE PLANTS WITH AND WITHOUT ARTIFICIALS.

Year.	Manured.			Unmanured.		
	Bushels	Cwt.	Bushels per cwt.	Bushels	Cwt.	Bushels per cwt.
1912	97·62	10·37	9·41	56·38	4·72	11·94
1913	90·06	11·55	7·80	59·81	6·78	8·81
Total and average	187·68	21·92	8·56	116·19	11·50	10·10

The difference in the bushel-weights of the manured and unmanured coffee should particularly be noticed.—Monthly Bulletin.

COFFEE CULTURE IN JAVA.

The climate of (the Botanical Gardens at) Buitenzorg, owing to its heavy rainfall (averaging 4,250 mm., or about 166 in.), its ill-defined dry season and fairly high temperature, is unsuitable for most species of coffee and for that reason, in 1901, a Coffee Experimental Garden was laid out in a district suitable for this plant at Bangelan at the foot of the slope of the Kawi mountain, near Malang.

The first seedlings of *Coffea liberica* were imported by the Gardens from Liberia in 1874-75 for the benefit of the coffee planters. Of no less importance was the importation, in 1901, of a number of Robusta coffee seedlings, which were planted in the Gardens at Bangelan. Various planters had likewise imported Robusta seedlings at that time, as well as about a year previously. A large number of the trees planted in Java, however, originated from the plants at Bangelan, and for some time past now the Government Experimental Gardens have devoted their attention to selecting the best and most productive Robusta trees, and utilizing them for planting up small subsidiary gardens, the best of which again serve as seed gardens.

That planters, we are told, prefer the coffee seed produced in the Government Coffee Experimental Gardens, is easily apparent from the fact that there is a big demand for coffee seed from Bangelan regularly every year, and in 1912 no less than 4,815 kilos, i.e., nearly 5 tons, of seed were supplied.

The importation and distribution of a variety very nearly related to Robusta, viz., the Quillou coffee plant, has been entirely the work of the Government Coffee Experimental Gardens. This species is even more productive than the Robusta, at least on most soils, but especially so on soil of a heavy nature. Its greater productivity has brought it to the front during recent years very markedly, and the demands for seed from the Experimental Gardens are every year in excess of the supply. All Quillou plantations in Java are comprised of the progeny of the twenty seedlings imported in 1901 by the Experimental Gardens.

The exceptional drought which characterized the years 1910, 1911 and 1912 brought to light the weak spot in both Robusta and Quillou coffee, viz., their sensitiveness to drought, in which respect they compare unfavourably with Liberia coffee; the last mentioned variety, however, owing to its susceptibility to leaf disease is now hardly planted at all. The dry years also induced the planters to consider the advisability of making an experiment with other coffee varieties similar to the Liberia species. The collection of coffee varieties in the Economic Gardens at Tjikeumeuh and in the Coffee Gardens at Bangelan provided the means for doing so, and the experimental planting of such coffee species has already been taken in hand on a few estates. The species in question are the following: *Coffea abeocula* (imported in 1898), *C. dewevrei*, *C. excelsa*, *C. dybowskii*, *C. arnoldiana* (all imported between 1905 and 1908), and *C. aruwimiensis* (1909).

Among the varieties of coffee to be found in the Economic Garden which have not yet been tested on a larger scale may be mentioned: *C. congensis*, *C. congensis var. Chalotii*, *C. laurentii*, *C. canephora var. Quillouensis*, *C. canephora var. Sankuruensis* (imported 1905-1908).

In the interests of the coffee planting industry both the Economic Garden and the Government Coffee Experimental Gardens have imported and distributed among the estates not only new coffee varieties, but also new shade trees, and especially green manures. Some of these came from foreign countries, but others were found in a wild state in Java itself, although they had not previously been utilized as shade trees or green manures.

As regards shade trees, when the "dadap serep" (*Erythrina lithosperma*), which was formerly in general use for the purpose, began to degenerate in consequence of severe attacks from all kinds of animal pests, experiments were undertaken in the Economic and Government Experimental Gardens with various species of trees belonging to the Leguminosæ family, and amongst those which have become popular and of which the seed has been distributed to coffee estates on a large scale, must be mentioned: *Albizzia moluccana*, *Deguelia microphylla*, and *Leucœna glaucœa*.

During the last few years planters have more and more come to realize the great importance of green manures,* and the advice and encouragement given by the officials of the Department have been of considerable influence in this respect. On coffee and hevea estates especially green manures are increasingly growing in favour. The few species which had been in use here and there for some seven or eight years, did not, however, give satisfaction everywhere, nor under all circumstances. It was therefore considered desirable to seek new varieties of Leguminosæ.

The Economic Garden has made experimental plantations for this purpose in recent years with about forty different varieties, some of foreign origin, and of others found in a wild state in Java. Some thirty of these have been judged suitable for use as green manures, and have been distributed among planters. Among these new varieties special mention must be made of the following: *Centrosema plumieri*, *Tephrosia candida*, *T. vogelii*, *Crotalaria striata*, *C. juncea*, *C. quinquefolia*, *Pueraria phaseoloides*, *Phascolus mungo*, *Vigna sinensis* (var. Iron cowpea).

The cultivation of coffee for the Government is compulsory on the natives, but this system is not being further extended—in fact, it is gradually being abandoned, and in a few years' time it will have become a thing of the past. The State derives a revenue from the system as a result of the natives being obliged to deliver the coffee to the Government coffee factories at a fixed price, which is calculated to leave the Government a certain amount of profit.

The Government, however, have not extended this system for some time past, and they are now gradually giving it up, as they have decided, on economic grounds, to abandon the system of compulsory cultivation and delivery. In 1911, the area of such plantations throughout the whole of Java amounted to 65,428 bahus (equal, we believe, to a boew or $1\frac{3}{4}$ acres, 1·754 to be exact); the output in that year was 11,776 piculs of Java, i,e., *Coffea arabica*, 5,114 piculs of Liberia, and 2,763 of Robusta coffee.

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* It was the knowledge of this that helped us in our decision to translate and issue De Sornay's book on the Leguminosæ and green-manuring now in the press.

Next month we hope to discuss Coffee, its cultivation and manuring, in Southern India, having just received from the author a useful brochure of forty-eight pages on the subject by MR. RUDOLPH ANSTEAD (Planting Expert to the Government out there), which has been issued by the Government Press at Bangalore for the modest sum of 2 annas, though worth much more. Meanwhile we notice that the MADRAS MAIL has its eye on the Brazilian output, for in its issue of February 11th its correspondent points out that it seems generally believed that this year's Santos crop will amount to about 8,000,000, bags, of which 4,675,000 bags had been received up to the end of November. MR. LANEUVILLE, whose figures are generally pretty accurate, is responsible for the following estimate of what the Brazilian position will be on June 30th next:—

		Bags
Visible supply, Nov. 30th		10,150,000
Receipts—Santos	3,325,000	
,, Rio	2,000,000	
Bahia and Victoria	400,000	
Milds	4,000,000	9,725,000
		19,875,000
Seven months consumption at 1,500,000 bags per month		10,500,000
Stock, June 30th, 1915		9,375,000

This compares with 10,651,280 bags on the same date last year.—TROPICAL LIFE.

Alkalinity in soils is caused by presence of lime salts, and in a few cases, particularly near streams of alkaline bore water, to soda carbonate. A slight alkalinity is favourable, but too much alkalinity may be detrimental to plant life. For this reason alkaline bore waters are not suitable for irrigation, although quite fit for watering of stock. To some extent such alkalinity can be improved by the application of gypsum.

Acidity in soil is caused when little or no lime is present in the soil, to neutralise the acidity formed by decaying vegetable matter and the natural acidity of some weathered rocks. Too high an acidity is detrimental, and can be improved by the application of lime in the form of slaked lime (burnt lime air-slaked).—QUEENSLAND AGRICULTURAL JOURNAL.

MESSRS. RUSSELL and BUDDEN, in discussing the results of the application of various disinfectants to the soil, conclude that none of the well-known antiseptics is as good as steam either in increasing the amount of ammonia in the soil, killing insect and fungoid pests, or in inducing a good soil development.

SOILS AND MANURES.

CALCIUM CYANAMIDE AS A MANURE.

A. MORETTINI.

There is still considerable uncertainty concerning the use of calcium cyanamide as a manure for olives and fruit trees, as seen in the lack of agreement in the results obtained by several workers. Realising the importance of the subject, the writer began a series of experiments in 1911 at the Royal Agricultural Institute at Perugia, at first with various fruit trees and later with olives alone. The following results were obtained from four series of experiments on olives, one of which was on a large scale in a private plantation.

The trees were divided into five groups of 12 each ; the whole 60 trees received a basal manuring of 12 cwt. of mineral superphosphate and 3 cwt. of sulphate of potash ; in each group increasing quantities of nitrogenous manure were given as follows :—Trees 1-2, 400 gms. (14 ozs.) per tree ; 3-4, 800 gms. (1 lb. 12 oz.) per tree ; 5-6, 1,200 gms. (2 lb. 11 oz.) per tree ; 7-8, 1,500 gms, (3 lb. 5 oz.) per tree ; 9-10, 2,000 gms. (4 lb. 7 oz.) per tree ; 11-12, 2,500 gms. (5 lb. 9 oz.) per tree. The nitrogenous manure applied and the results obtained in each case are given in the following table :—

Group.	Manure.	Yield of Olives in 1912.	Prunings, April 1913.	Yield of Olives Nov. 22, 1913.	Prunings, April, 1914.
		lb.	lb.	lb.	lb.
A	Calicium cyanamide, granular (1911) ...	35·6	324	—	—
	Nitrate of Soda ...	—	—	64	291
B	Calcium cyanamide in powder (oiled) ...	192·8	372	255	313
C	Sulphate of ammonia ...	202·8	395	266	271
D	Nitrate of Soda ...	202·4	267	332	317
E	Control ...	150·3	357	163	328

The conclusions drawn from these results are as follows :—

(1). In fairly heavy marls, cyanamide as prepared at present (in powder), applied as a top-dressing and lightly dug in, is not injurious to olives even in quantities of $5\frac{1}{2}$ lb. per tree.

(2). In the granular form, however, as previously sold, cyanamide applied in the same manner on the same soil is injurious, even at the rate of 14 oz. per tree.

(3). When stored in a dry place from one year to another its fertilising value is diminished, but it does not become injurious.

(4). In these particular soils the manure gives good results when applied during the winter and early spring (April).

(5). The fertilizing action of cyanamide on olives is very pronounced; but the order of efficiency of the three nitrogenous manures is as follows: nitrate of soda, sulphate of ammonia, cyanamide.

(6). From an economic point of view the above order would be changed and cyanamide would come before the other nitrogenous manures for olives, as for field crops, on these soils.—MONTHLY BULLETIN.

A NEW METHOD OF FUMIGATING SEEDS.

An interesting and successful method of destroying weevils, beetles and similar insects infesting seed* is described by MESSRS. SASSCOE and HAWKINS. The method may be described as cyaniding under reduced pressure. The seeds are placed in an iron cylinder 3 feet long by 1 foot in diameter. One end of the cylinder is permanently closed, and the other, fitted with a flange, is closed by means of a brass plate ground to fit the flange. By means of screws the plate is clamped against a rubber washer fixed between it and the flange. The cylinder is fixed in a horizontal position, and in its upper side are three openings. One is fitted with a cock which connects up with a vacuum pump, and into the third is fitted a funnel provided with a stop-cock and containing the acid required to produce the hydrocyanic acid. The end of the funnel passes nearly to the bottom of the cylinder and opens above a vessel containing the required amount of potassium or sodium cyanide. To use the apparatus the seeds to be disinfected are placed in a canvas bag in the cylinder and the required amount of cyanide is put in the vessel below the funnel. The plate is screwed on and the stop-cock connected with the pump. When the gauge registers a decrease of pressure corresponding to about 30 inches of mercury—that is, an almost complete vacuum—the pump is cut off by closing the stop-cock, the acid is run in through the funnel and the seeds are exposed for half an hour to the hydrocyanic acid. It is, of course, important to arrange for the discharge pipe of the air pump to open outside the building. After the seeds have been exposed to gas the stop-cock of the funnel is opened in order to let air into the cylinder. Air is sucked through the cylinder by means of the pump, and thereby the hydrocyanic acid is washed out. When this has been done the cover is taken off and the seeds are removed. Extensive trials indicate that by this means insects are destroyed and the germination of the seed is not impaired. The advantage claimed for the method is that better contact is obtained between the gas and the insects, and hence that the hydrocyanic acid produces its lethal effects more swiftly.—GARDENERS' CHRONICLE.

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* Bulletin No. 186 of the U. S. Department of Agriculture.

CO-OPERATION.

SIR HORACE PLUNKETT ON CO-OPERATION.

[*Address at the Congress of Tropical Agriculture.*]

We are to deal to-day with a subject to which perhaps I may attach undue importance, but as we have to deal with it in an hour, that renders it impossible for me to do justice to the subject without doing grievous injustice to those who have prepared papers, and to those who wish to hear them. I recognise that there is one limitation upon our discussions. We are not here to treat of general principles, but rather of their particular application to certain countries, so that I shall devote the very few remarks I shall make to what you may possibly find of suggestive value in the co-operative movement generally in these islands.

As we all know, the co-operative movement began in England in the "hungry forties," and has extended since all over the world in its various forms. The first thing that I have to say about the co-operative movement in England is that it hardly touched agriculture at all until the beginning of the present century. In Ireland, on the other hand, just a quarter of a century ago, the agricultural co-operative movement was founded to deal with the special circumstances of that country, and there are, I think, a few points in that movement which are worthy of consideration from those who come from tropical countries. Ireland, of course, is a country where, meteorologically speaking, the temperature is low, and I realize that I must remember the warning given to us by the President of the Congress in his opening Address that no knowledge of general principles will avail without a knowledge of the conditions of tropical countries. But in Ireland we had to supplement an agrarian revolution, which was about to transfer, and has now about half transferred, the agricultural land of the country from a small class of landlords, largely regarded as aliens, to a numerous class of cultivators, mostly peasant proprietors. The State, by the advance of some £ 200,000,000, sterling, and large sums given as a free grant, are carrying out this huge transaction, but they are doing nothing, and could do nothing, or could not do much, to make the necessary changes in the social economy of the agricultural classes which would be required in order to enable the new owners of land to prosper, and to fulfil their huge obligation to the State. We laid down, after years of thought and experiment upon the question of a satisfactory rural economy, two main propositions. The first is that if you want to solve the modern problem of rural life—that is the problem of inducing and enabling people to maintain a decent standard of comfort in a rural existence in these days of world-wide competition—you have to approach the problem from three points of view. You have to look upon agriculture as an industry, as a business, and, what is perhaps more important than all, as a life. You have to bring into industry the teachings of modern science, into business the methods of our modern business, and into life a scheme of social attraction and amenities; certain intellectual advantages which will enable rural life to resist the lure of the city. The first proposition is, then, that you have to

deal with the problem on its three sides; and the second, that you must deal with the business of farming, and the chief reform you have to make there is to introduce methods of combination. We live in days when everything has to be done in a large way—to be done to pay—and when the small producer is at the mercy of powerful middle interests, trusts, combines, and so forth; so that the first thing is to get a sound economic basis by teaching the farmers to combine, and the only method of combination which is suitable to farmers, as we all know, is not the joint-stock method, but the co-operative movement. I have always felt that the reason that agricultural co-operation lags so far behind—the reason why even in this Congress it is not thought necessary to give more than an hour or so out of a week to the discussion of agricultural co-operation—is that in the urbanization of all thought people in these days think the town method is suitable to the country conditions. They are still hankering after the joint-stock method, and have not yet learnt that co-operation is the only method suitable to agricultural conditions. Therefore, we say you have to start by teaching co-operation, and that until you have done that you cannot successfully introduce scientific methods into the practice of agriculture, nor until you have got people to come together in the business of their lives, can you get them to come together for higher intellectual and social purposes.

Our formula in Ireland for solving the rural problem has some notoriety now. It is better farming, better business, better living, and we say that you must begin with better business, and that better business is co-operation. Now I say nothing about the Eastern origin of the most typical of the Irish people. I think myself that their addiction to co-operation has a great deal to do with that. But, broadly speaking, the Irish people belong to the associative races rather than to the individualistic, and that is a tremendous advantage, and it is in that respect that I think many of the tropical countries, especially India, might learn a great deal from our work in Ireland, not so perhaps from the successes as from the failures. I myself have had five-and-twenty years of work in that country, and I have learnt far more from my failures than I have from my successes; and I am in a position now, in dealing with people who have the same kind of outlook towards this problem, to suggest to them how to avoid many of the mistakes we have made

The most important respect of all, I should say, in which co-operation in dealing with the tropics has to be studied is in the precise relations which ought to exist between State assistance and organized voluntary effort. As you go down in the economic and social scale, it becomes more and more necessary to develop self-reliance, but at the same time it is more and more necessary to begin with State assistance without weakening the patient's resistance to the many diseases which attack the principle of self-help.

I have one practical suggestion to offer, and that is that this Congress should recognize that agricultural organization is not an amateur business but a very highly technical business, and that men must be trained for it if they are going to have any success in it. That we have learnt in Ireland ; they have learnt it in England ; and they have learnt it in Scotland. We have had in these countries, where the whole trend of thought had gone against co-operative action, to found agricultural organization societies simply and solely for the purpose of teaching people who do not understand co-operation how to organize co-operative associations for every agricultural purpose ; and

I happen to know that they are coming to this view in the United States and in Canada, and that schemes are on foot for training organizers to start co-operative movements in these countries. I believe that at the Tropical Agricultural College which is about to be founded somewhere in the Empire, in order that teachers qualified to teach scientific principles of agriculture should be able to learn how to apply those principles to tropical conditions, it is highly important that agricultural co-operation should be taught in this College, and that the agricultural organizer, even if he has learnt his business, as he can learn it in these islands, should go there and learn how to organize in the wholly different conditions of the tropical countries —PROCEEDINGS OF THE THIRD INTERNATIONAL CONGRESS OF TROPICAL AGRICULTURE.

COW PEAS AS FODDER FOR STOCK.

Writing in the AUSTRALIAN SUGAR JOURNAL on the above subject, MESSRS. H. A. PETERSON, LTD., of Brisbane, tell us that the following are a few reasons why cow-peas *(Vigna catjang)* should be more generally grown. Probably 90 per cent. of the general farming community are not yet fully acquainted with the value of this highly important legume, viz :—

(1) As a nitrogenous fertilizer they may be classed as perhaps one of the best in existence ; they are easily grown, and thrive practically in any soil so long as they are favoured with a little moisture during their growing period. They are a manure to any crop, whether it be sugar, fruit, maize, strawberry culture, or even general farming requirements.

(2) In addition to their value as a fertilizer, they are a good weed eradicator, inasmuch as they grow so dense that weeds of any description will not thrive in close proximity to them.

(3) When fed to dairy cattle, and used with a corn forage as a silage crop, they greatly reduce the cost of feeding. Recent experiments in U. S. A. show that in a trial, cows getting cow-pea hay average 1·3 lb. more milk daily than those feeding on wheat bran.

(4) For pig-raising they are invaluable. Experiments made in New Zealand with three 50 lb. pigs, in a field pasture of cow-peas, given corn additional, and a second lot of three fed on corn only, in a trial lasting forty-two days, showed that the pigs ranging in the cow-pea field gained nearly three times as much as those fed on corn alone.

(5) Cow-pea hay for horses : In a feeding trial at a North Carolina Station in U. S A., it was proved that cow-pea hay combined with corn and cob meal made a most satisfactory work ration. Cow-pea hay, with a reasonable quantity of corn, would be a good substitute for bran and oats.

Farmers and planters, therefore, should make a special effort to plant large areas. One bushel of seed planted in drills will be sufficient to sow four acres.—TROPICAL LIFE.

GENERAL.

CEYLON AGRICULTURAL SOCIETY.

BOARD MEETING.

Minutes of a meeting of the Board of Agriculture held at the Council Chambers, Colombo, on 23rd February, 1915.

The Hon'ble the COLONIAL SECRETARY presided.

The following were also present :—The HON. MR. BERNARD SENIOR, SIR S. C. OBEYESEKERE, SIR HECTOR VANCUYLENBURG, HON. MR. A. S. PAGDEN, HON. MR. A. KANAGASABAI, HON. MR. A. J. R. DE SOYSA, HON. MR. K. BALASINGHAM, HON. MR. T. B. L. MOONEMALE, MUDLR. A. E. RAJAPAKSE, THE DIRECTOR OF AGRICULTURE, DR. H. M. FERNANDO, MESSRS. W. A. DE SILVA, H. L. DE MEL, M. K. BAMBER, D. S. CORLETT, A. BRUCE, G. A. JOSEPH, A. W. BEVEN, SAM. W. SOYSA, F. L. DANIEL, and the SECRETARY.

Minutes of the meeting held on November 23rd, 1914, were read and confirmed.

Progress Report No. LXVI. was adopted.

Statement of accounts for the last quarter of 1914 was tabled and passed.

SIR HECTOR VANCUYLENBURG moved the following resolution :—"This Board desires to place on record its deep sense of sorrow at the untimely death of Captain A. N. GALBRAITH, a former Secretary of the Ceylon Agricultural Society." The HON. MR. T. B. L. MOONEMALE seconded.

THE DIRECTOR OF AGRICULTURE moved the following resolution :—"That this Board do record its regret at the death, which occurred suddenly on February 3rd, of MR. ANDREW RUTHERFORD, Government Entomologist, a member of the Board—a competent and efficient officer with a promising career—and expresses its sympathy with MRS. RUTHERFORD and her infant son." MR. A. W. BEVEN seconded.

Both resolutions were passed in silence, all standing.

A meeting of the Society followed, at which the DIRECTOR OF AGRICULTURE presided. MR. W. A. DE SILVA read a paper on "Some primitive processes of Agricultural practice and their significance."

DR. H. M. FERNANDO, MR. A. W. BEVEN and the CHAIRMAN offered remarks and MR. W. A. DE SILVA replied.

A hearty vote of thanks was accorded to the writer of the paper.

C. DRIEBERG,
Secretary, C. A. S.

Peradeniya.
23rd February, 1915

MARGARINE.

VEGETABLE OILS AS BUTTER SUBSTITUTES.

Until the last few years the word margarine was usually associated, in the mind of the British public, with poverty ; but now, under the new name of "Nuts and Milk," with which advertising enterprise has made us familiar, it is becoming freely used in the kitchen, and is even found on the breakfast

table in many households. On the continent, where the general standard of luxury is not so high as here, butter substitutes are used far more generally; and the demand for the raw materials from which they are made has increased to such an extent as to cause a noteworthy increase in their cost. In most cases the legislation affecting butter substitutes has been influenced by vested interests, so that, whilst only partially effective in preventing fraud, it has checked the development of the industry. Taking into account also the universal prejudice against margarine which prevailed formerly, it is very remarkable that the industry should have made such advances. It is of interest, therefore, to examine its development in some detail, more particularly from the scientific point of view; for it is desirable at the outset to emphasise that the margarine industry is essentially scientific in character, and that considerable technical skill is demanded in its manufacture.

The finished margarine must be satisfactory in taste, odour, and texture; this necessitates that the fats composing it shall be entirely free from fatty acids, and show no tendency to become rancid. Much depends on the texture of the fat, which the user expects to be the same as that of butter. The margarine maker so blends his raw materials that the mixture has the same melting point as butter, and he is able, further, to vary the melting point to suit the climate, an advantage which will be more fully appreciated in the future when margarine has found its way to tropical countries.

The present success of the margarine manufacturer is to a large extent due to the great variety of raw materials which are now available. In the early days of the industry soft beef fat was the sole basis obtainable; this was known as oleo oil or oleo margarine, and the conditions of its manufacture were not always above suspicion. This has now been entirely changed; the factories are models of cleanliness; they are officially inspected, and above all, animal fats have become of secondary importance to vegetable oils.

The process of manufacture is briefly as follows:—The carefully purified oils are blended at a suitable temperature, churned and pulverised with new or separated milk in suitable machines, cooled, washed, salted if required, and worked in exactly the same way as butter. The product is a butter substitute, and has the same composition, viz., about 84 per cent. of fat. Therefore, on the accepted standards, it has the same nutritive value.

A certain amount of butter fat is usually contained in the mixture, but by law this is not allowed to exceed 10 per cent. In Germany, Austria, and Denmark the presence of 10 per cent. of Sesame oil is obligatory for the purpose of ear-marking the substitute. Sesame oil gives a colour reaction with certain reagents, which enables its presence to be readily detected; for the British palate this addition of Sesame oil is unwelcome. In Belgium the addition of 0·2 per cent. of potato starch, as well as of 5 per cent. of Sesame oil to margarine is obligatory. It may be remarked that the analytical discrimination between butter and margarine is a lengthy process, and that the detection of 10 to 15 per cent. of added fat to butter is a matter of considerable difficulty. All fats are very much of the same composition, and with one or two exceptions they lack individual characteristics. The analyst depends, therefore, on small differences in physical characteristics, or on the proportion of fatty acids or low molecular weight, for their identification when in admixture.

It is an increasing practice in factories and for culinary operations in restaurants or in the kitchen to use the pure or blended fats themselves without churning them with milk. The advantages of this procedure are obvious, and it will be followed more generally by the housewife in the future. Thus in the United States, and in the poorer districts of our large towns, enormous quantities of refined cotton seed oil are sold for frying purposes, and the use of nut and blended butters containing 100 per cent. of fat for the same purpose is largely on the increase amongst the upper classes.

With the exception of olive oil the edible vegetable oils require very special refining before their characteristic flavours or impurities can be removed ; in consequence it is only since these difficulties have been overcome in practice that they have been so largely used for margarine. It is certain that as the knowledge of refining processes increases, the development of the industry will be still greater. The methods of refining vary according to the oil ; they are most jealously guarded as valuable secrets.

In Britain, and particularly in the United States, very large quantities of cotton seed oil are used either in margarine or for culinary purposes, both as a substitute for olive oil and as a cooking fat. About three-fourths of the world's production comes from the United States, about half of this oil being refined for edible purposes. The crude oil obtained by pressing the seed is first treated with caustic soda, then with Fuller's earth, and finally made as nearly as possible free from taste and odour. From the point of view of the margarine maker, cotton seed oil is too liquid to be used in any large proportion, though its relatively low cost makes it a very desirable ingredient.

Far more important as butter substitutes are the nut oils—coconut, and palm kernel. The former is obtained by pressing copra—the flesh of the coconut, which is exported in a dried condition from its place of origin. In the past the copra-pressing industry has been localised at Marseilles, though in later years an almost equal quantity of material has been dealt with at Hamburg.

Palm kernels are the seeds of the palm fruit, of which the fleshy part is utilised for the manufacture of palm oil. The natives on the West Coast of Africa collect the kernels, and crack and remove the shell before the nuts are exported to Europe. It is stated that kernels were first brought to Marseilles as ships' ballast and thrown into the sea on arrival until their value was recognised. Originally the chief receiving port was Marseilles, but latterly the industry has been almost entirely carried on at Hamburg where in 1911, 93 per cent. of the total quantity was dealt with, the remainder going to Liverpool.

The palm kernel oil made in North Europe last year is estimated at 125,000 tons, of which about 40,000 was refined for edible purposes. The kernels contain about 50 per cent. of oil, which is extracted by pressing in hydraulic presses similar to those used for copra. The residue, palm kernel cake or meal, has found a very wide use in Germany as an ingredient of compound cake for cattle feeding, and in this form has been largely exported to England. The commercial success of the pressing industry largely depends on the price obtained for this meal, and no pains have been spared on the Continent to demonstrate its value to the farmers by means of scientifically conducted feeding trials. There is at present much talk of developing the industry in Britain, in which case the disposal of the cake here will be an important consideration. It is of interest that the decline of the industry in Marseilles is largely due to the cake failing to find a ready sale as cattle food in the South of France. If the new industry is to succeed here it will have to be supported by the agricultural interests.

Some idea of the magnitude of the nut oil industry is gained from the following figures:—The world's production of coconut and copra oil, 1913-1914, is estimated at 377,000 tons, of which 300,000 tons were used in Europe. The total supply of hard vegetable fats (coconut and palm kernel oil) available for margarine is said to have been 240,000 tons in 1913 and perhaps 300,000 tons in 1914. Out of 347,000 tons of hard fat stated to be used for margarine in 1913, 204,000 tons were vegetable, and the quantity of vegetable fat used in 1914 may have amounted to 300,000 tons, i.e., the total visible supply. There is little wonder that there has been a great increase in the price of these oils, and that the tropical sources of palm tree oils are being widely exploited. Nearly all tropical countries report an increase in the area under coconuts,

or an improvement in the methods of dealing with the existing trees and in the machinery for making copra or extracting the oil, which is still very primitive and inadequate.

The nut oils resemble butter and differ from all other fats in containing a large proportion of fatty acids of low molecular weight. Butter contains acids from butyric acid upwards in the homologous acetic acid series ; the chief constituent of nut oils is lauric acid. Few of the remaining oils of commerce contain acids lower in the series than palmitic acid.

In preparing vegetable fats for the market the all-important consideration is the careful selection of the raw materials. The oil is worked as fresh as possible, so that the best results are obtained when the seed is present in this country. It should be understood that the refining process involves no treatment with chemicals except the agitation with weak alkali to remove the fatty acids present.

The importance of fats in the dietary requires no emphasis ; on the other hand, it is questionable whether all fats have the same value as food materials. Fats, being glycerides, are decomposed in their passage through the alimentary system into glycerol and fatty acids. The decomposition is effected through the agency of an enzyme, lipase, so that the digestibility of the fat depends on the rate at which it is attacked by the enzyme. The fat has to be brought into a suitable state of emulsification before the enzyme can act on it ; and though the factors controlling this state are still somewhat obscure, it is above all-important that the fat should melt readily at the temperature of the body. Hence the comparative digestibility of a fat is in the first place based on its melting-point. Stearine is badly digested, liquid oleine is readily digested. The addition of sufficient oleine to stearine so as to reduce the melting-point of the mixture renders the stearine also digestible. Consequently the all-important point which margarine makers keep in view is the melting-point of their product in relation to the body temperature ; if this is correct the material may contain some ingredients of a considerably higher melting-point.

It is of interest to note in this connection that vegetable fats are composed to a great extent of mixed tri-glycerides—that is, the glyceride contains more than one fatty acid in its molecule, whereas normally one molecule of glycerol is coupled with three molecules of the same fatty acid. Experience teaches that the melting-point of the fat will be greatest when these are all the same. The melting-point of the fat is further influenced by the fact that it consists of a number of different glycerides, both simple and mixed. Since mixing of fats has the result of altering the relative proportions of these, it is evident that the final melting-point of a mixture cannot be predicted on theoretical grounds, and it is agreed that butter substitutes of suitable melting-point are as digestible as butter.—Nature.

LAWN MAKING IN THE TROPICS.

One frequently hears complaints of the difficulty experienced in laying down a lawn and the disappointing results that follow all the labour and expense involved.

Such disappointment is bound to be the experience of those who try to follow the methods of lawn-making and use mixtures of grass seeds employed in temperate climates. These mixtures might do at high elevations but are not suitable for "the plains."

The rules for lawn-making are very simple.

(1) Thoroughly work up and clean your land and level it.

(2) Bring the soil to a proper tilth.

(3) Plant or sow the proper grasses.

(4) Water and roll and continue to do this; manuring as necessity arises.

It was an old gardener at one of the Universities who is said to have told a visitor that it was quite easy to make a good grass-lawn if you just rolled and watered it for three hundred years.

The PIONEER in a recent issue refers to the subject of lawns in India.

The most suitable variety of grass for low elevations is *Cynodon dactylon* or Doob grass (the common "horse-grass" of our roadsides) and this is planted in one of two ways:—(1) Dibble bunches of runners into holes 6 inches apart in the prepared ground, keeping about 3 inches of the plants below ground and 3 inches above; afterwards attending to weeding, replacing of dead tufts, watering, rolling and mowing. (2) Chop up the grass runners into lengths of 1 or 2 inches, mix with cow dung and water or liquid mud and spread over the surface, covering with dry grass or straw and watering till the plants are established.

PROF. WOODHOUSE of the Sabour Agricultural Society recommends a thorough preparation of the land by ploughing and harrowing so as to produce a perfect tilth, planting patches of the grass in showery weather to save watering and allowing the plants to spread.

In places where the grass has not spread the soil should be harrowed or raked to conserve moisture and induce the growth of the runners: but if the bare patches persist they will have to be planted up separately.

It is also possible to make good lawns by sowing Doob grass seed, which could be had for about Rs. 2·50 a pound.

Another good land grass is *Paspalum longiflorum*, also to be found on roadsides. It is of a creeping habit and forms a soft sward. The grass-cutters about town could be got to collect this grass but care should be taken that they supply only plants of the kind desired.

As has already been remarked, given a suitable grass success depends entirely upon the proper preparation of the land, and careful after-treatment consisting in the frequent use of the hose, lawn-mower and roller.

A very complete description of lawn-making is to be found in MACMILLAN'S HANDBOOK OF TROPICAL GARDENING.

NATIONAL FARM CO.

DEPOT

Diyatalawa Mills, Vauxhall Street, Slave Island.

Fowls **Rs. 18, 15, 10·50,** and **Rs. 9** per dozen. Ducks **Rs. 15,** Geese **Rs. 60,** Turkey cocks **Rs. 120,** Turkey-hens **Rs. 90** per dozen.

Guinea fowls **Rs. 48,** Pigeons **Rs. 6,** Partridges **Rs. 6,** per dozen.
Quails to order.

Pigs, Porkers, **cts. 35** per lb. live weight, Sucklings **Rs. 7·50, 5** and **3.**

Eggs, fresh, **75 cts.** per dozen.

Telephone 1087 and 285. **Telegrams: Wally, Colombo**

Usual discount to the TRADE.

RAISING OF QUICK-GROWING FOOD CROPS.

As a result of the *free distribution of seeds* during October-November 1914, for which the Society voted a sum of Rs. 1000, there has been an abundant supply of quick-grown food stuffs in the village markets. Several very favourable reports have been received from those to whom seed was distributed.

Mr. H. E. Ameresekera, Mudaliyar of Magam Pattu, reports:—

"In October last the Secretary of the Ceylon Agricultural Society sent a supply of seed of different varieties of vegetables, as well as Sorghum and lab-lab bean.

2. The seed was distributed to the holders of the Crown lands leased for Cotton, the cultivation of which had to be abandoned. It was also given to chena cultivators to be grown along with dry grains. An extent of about 25 acres, in plots varying from ½ acre to 2 acres, was cultivated throughout the Pattu. The crop everywhere was excellent. There was an abundant supply of these vegetables at the local markets. Special mention must be made of "Mochcha" (lab-lab) Beans and Brinjal, which gave excellent results.

3. A supply of mun (green gram), Indian Corn and Sorghum was also received and distributed. The Mun and Indian corn did not give as good a return as the seed sown early in October by the villagers, evidently owing to late sowing. Sorghum proved a decided success. It grows luxuriantly and is well adapted to the soil. Its cultivation has created a very favourable impression in the minds of the villagers, not only on account of its abundant yield but also from the villagers' point of view that it does not entail such labour in grinding into meal as is the case with Indian Corn, which has further to be detached from the cob. It remains to be seen whether they will grow it. The general opinion is that it is a valuable food product and is not so "heaty" as Kurakkan. The only difficulty is found in protecting the ripening grain from parrots and other predatory birds. These birds are very fond of it. The last crop was destroyed to a considerable extent, especially in the remoter parts of the country, where these invaders were found in enormous numbers, and the villagers were unwilling to destroy them, owing to their natural aversion to the destruction of bird life."

Mr. C. Dias has sent the Society 3,300 seeds of snake gourd, the produce of a packet of seed supplied to him during the distribution.

Encouraging reports on the cultivation of Dhura have been received from 18 School Gardens. Samples from Ankumbure and Tenne Schools near Matale were forwarded to the Manager, Experiment Station, who passed a very favourable opinion on them.—C. A. S. Progress Report.

GRAIN SORGHUMS.

O. O. CHURCHILL and A. H. WRIGHT.

This bulletin *(Oklahoma Sta. Bul. 102)* discusses grain sorghums with special reference to Oklahoma conditions and treats of their history, distribution, classification, seed and seed selection, standard of perfection, soils and soil management, methods of cultivation, harvest, rotation, storing, handling, and uses, including composition of the grain, insect enemies and diseases.

In discussing moisture requirements the results of pot experiments are given that show the influence of 5, 10, 15, 20, 25, 30 and 40 per cent. water content of soil on Kafir corn, milo maize, corn, broom corn, and oats.

Practically no growth with broom corn or oats occurred in the pots containing 5 or 10 per cent. of moisture.

"In all series the amount of water required to produce a pound of dry matter decreased as the water content approached 25 per cent. This is approximately 55 per cent. of the total water-holding capacity of the soil. The amount of water required to produce a pound of dry matter increased above this per cent. This indicates that plants make the most economical use of water in this soil when moisture content is about 20 per cent.....

"From 15 to 30 per cent. moisture the growth increased nearly in proportion to the increase in moisture present. The plants grown in soil containing 40 per cent. moisture did not show any decided increase in dry matter over those grown in 30 per cent.....

"The sorghums grow and produced well with 15 per cent. of water in the soil.

"This test indicates that Kafir and milo will grow and produce fair crops when the water content of the soil is too low for the production of corn."

In a series of pot tests run to determine the wilting coefficient of corn, oats, Kafir corn, milo maize, and cowpeas, the recorded results show that it requires a longer period of time for the grain sorghums to reach the wilting point than it does oats and corn. Cowpeas were next to the grain sorghums in this respect.

Oats removed more of the moisture from the soil before wilting than any other plants grown; cowpeas ranked next to oats, corn third, Kafir corn fourth, while milo maize left more of the moisture in the soil at its wilting point than any of the other crops.

From the wilting coefficient for the plants as determined, it is shown that the drought-resistance character of the grain sorghums is not directly due to their ability to use the soil moisture down to the lowest extent.

When two kinds of plants were grown together in the same soil mass, corn died before oats, Kafir corn, and milo maize, and in one case it died before cowpeas. Kafir corn grown in combination with other crops was in every case the last to die.

In experiments regarding the depth of ploughing, it is noted that "soils of silty character were ploughed to a depth of 5, 10 and 15 in. Just previous to the ploughing each year samples were taken to a depth of 15 in. in each series. In each case of three successive years it was found that the soils which were ploughed to a depth of 15 in. were just as hard and compact in structure as those which were ploughed to a depth of 5 in. There was no residual effect upon the soil from deep ploughing. The effect entirely disappeared at the end of the first season. It may be further stated that in ploughing the second and third years the 5-in. ploughed plats were just as easily turned as were the 10 and 15-in. ploughed plats. This leads us to believe that extra deep ploughing, that is, over 7 in., is not profitable on this type of soil."

It is noted as results of trials, that Kafir corn should be planted about April 10 in the southern part of Oklahoma and about May 20 in the northern part. Feterita and milo maize may be planted about ten days later than Kafir corn.—Experiment Station Record.

DETERMINATION OF SEX.*

The problem of sex-determination has long excited the curiosity of mankind. "Male and female created He them," said the writer of Genesis, but men have long since refused to be satisfied with this dictum. For centuries they have been trying to get behind it, and many and varied have been the suggestions put forward at one time or another. Most of these refer to animals, for it is in animals that the distinctions of sex are most obvious and make a more direct appeal to the average man. The botanical side of the problem developed at a later date, for it was not until the end of the seventeenth century that CAMERARIUS demonstrated the sexuality of plants. Nevertheless, we know that the phenomena of sex in plants often offer close analogies to those observed in animals, and it is reasonable to suppose that the solution of problems connected with the former will help to a better understanding of those among the latter. Although DR. DONCASTER has expressly limited himself to animals, the horticulturist of an enquiring turn of mind can hardly fail to find it full of interest.

The many and various theories advanced as to the determination of sex fall into three groups according as they assume that it takes place before, during, or after the act of fertilization of the ovum by the sperm. Among older writers there was a tendency to regard the developing embryo as indifferent up to a certain stage, and it is true that even careful microscopical examination failed at that time to reveal any sexual differences until some time after the beginnings of the various organs of the body could be clearly distinguished. It was suggested that the sex might be determined during this apparent indifferent stage by such factors as an alteration in the conditions of nutrition in the mother. DR DONCASTER points out that modern research tells strongly against this view. There remain the other two hypotheses—that it is determined at fertilization, and that it is determined before fertilization. The remarkable case of the honey-bee appears at first sight to suggest that the moment of fertilization may be that at which sex is determined. Many years ago DZIERZON put forward the view that the queen lays two kinds of eggs—those which are fertilized and those which are not. After her nuptial flight she carries a store of sperms, and it seems to be under her control whether she allows the eggs as she lays it to be fertilized from that store or not. If fertilized it develops into a female (worker or queen according to the way in which the larva is fed); if unfertilized it eventually becomes a drone. Evidently in the bee sex is determined by the act of fertilization. This cannot, however, be true in the great majority of animals, where we know that every egg must be fertilized before it can develop further, and yet either sex may result. We are thrown back on the hypothesis that sex is predetermined either in the ova or in the sperms, or in both. DR. DONCASTER points out that modern work has revealed good evidence for supposing this to be a true hypothesis, that in some animals there are male and female sperms. The evidence is of two kinds, derived partly from a microscopical study of the sexual cells themselves and partly from the observed behaviour in heredity of certain sexual characteristics. The microscopical evidence is discussed by DR. DONCASTER in his chapter on "The Material Basis of Sex-determination," with the authority of one who himself worked in this field of investigation. In some of the animals, notably in certain insects and in mammals, it has been shown that the sperms can be referred to two classes, according to the number of chromosomes that they contain. The ova, on the other hand, are at any rate visibly, all of the same

* THE DETERMINATION OF SEX. By L. DONCASTER. (Cambridge University Press.) 1915. Price 7*s.* 6*d.* net.

kind, and possess the same number (x) of chromosomes as the sperms with the higher number. When an ovum is fertilized by a sperm with the higher number of chromosomes the resulting individual has xx chromosomes, and is a female; when an ovum is fertilized by a sperm with a lower number of chromosomes the individual resulting has xy chromosomes, and is a male. The number of chromosomes in the tissues of the two sexes has been examined and found to agree with this deduction. The evidence for the existence of two classes of sperms respectively, male-producing and female-producing, is supported in a remarkable way by the mode of inheritance of certain sex-limited characters. Thus the little pomace fly (Drosophila ampelophila) may have either red or white eyes, red being in Mendelian terminology dominant. When a red-eyed male, however bred, is mated with a white-eyed female, all his daughters have red eyes and all his sons white. The male transmits his colour only to his daughters. On the other hand, a red-eyed female, capable of transmitting the white eye, when mated with a white-eyed male, hands on red or white impartially to her offspring of either sex. Now it is known that Drosophila produces two kinds of sperms. If it be supposed that the factor which gives rise to the red eye is linked with the sex factor for femaleness in the sperms which contain the extra chromosome, and does not occur in the sperms that lack the extra chromosome, we have a simple explanation of this curious hereditary phenomenon. In other words, the facts of sex-limited inheritance support the view that in one sex, at any rate (in Drosophils the male), the germ cells are already differentiated as regards their sex-producing potentiality before fertilization occurs.

While the fact of sex-limited inheritance suggests that in some cases it is the male that forms male-producing and female-producing sperms, it is equally clear that in other cases, especially in moths and birds, it is the female that produces male-bearing and female-bearing eggs. For in such cases the position found in Drospohila is reversed, and it is the female that transmits a given character only to her male offspring. Owing partly to the greater difficulty of manipulating eggs as compared with sperms the microscopical evidence is not as clear in this group of cases as in the other. DR. DONCASTER brings forward some evidence suggesting that in moths, at any rate, the female may produce eggs of two kinds as regards the number of chromosomes. But he points out that more work is necessary before certainty can be attained.

Enough has been said to show how strong is the case for supposing that sex is an attribute of the germ-cells themselves, and we may leave the reader who is interested to consult DR. DONCASTER for the way in which such cases as that of the honey-bee are brought into line with this view. Though we are now compelled to suppose that sex is inherent in the germ-cells themselves, at any rate in those of one sex, it is evident from statistics that the two sexes are often produced in proportions which differ more or less widely from the equality which that supposition demands. In man, for example, the number of males born is roughly 5 per cent. more than that of females, the excess of the latter among adults being due to the higher mortality of the male sex. In a chapter on the sex-ratio the author discusses the matter, and points out that the varying proportions of the sexes at different age periods may be due to influences which act during development more favourably upon one sex than upon the other. Statistics are always apt to be misleading unless the circumstances in which they were collected are fully known, and nowhere, not even in political discussion, is this more true than in the problems of biology. For this reason figures which reveal the sex-ratio as even more widely divergent from the expected equality are not necessarily evidence against the production of male-bearing and female-bearing germ-cells in equal numbers. Between the formation of the germ-cells and the sexually recognisable individuals they help to make there are many stages

and many vicissitudes. If these are more favourable to the developing young of one sex than of another the sex-ratio may easily be modified. And it must not be forgotten that there may be discrimination among the germ-cells themselves before fertilization occurs.

On the whole the evidence is strongly in favour of the view that sex is an attribute of the germ-cells. At fertilization the sex of any given individual is fixed according to the type of germ-cells that went to its making. There is no reason for supposing that we can alter the sex of a developing individual when once that individual has arisen through an act of fertilization. Some control of the output of the two sexes is not beyond the bounds of possibility. But it is more likely to come through some method of discriminating destruction applied to the germ-cells than in any other way. If, for instance, we could discover a method of treatment which acted with more deleterious effect upon the male-producing germ-cells than upon the female-producing we could increase the output of females at will. At present there is little more than vague suggestion as to the possibility of such treatment proving efficacious. Yet anyone who reads DR. DONCASTER's cautious and scholarly presentation of the evidence cannot fail to realise the great progress that has been made in the past ten years towards a proper understanding of the biological nature of sex. After centuries of speculation we are at last beginning to touch certainty. The little sure knowledge that has been gathered in will only serve to heighten the fascination of the mysterious and still unexplored beyond where lie hid the secrets of sex and, perhaps, even of life itself —GARDENERS' CHRONICLE.

ONION CULTIVATION.

THE TEACHER, Udispattu Boys' School, furnishes results of a trial in growing onions, using seed in place of bulbs. Half an ounce of seed gave a return of 36 lb. of bulbs which fetched Rs. 3/60. The cost of seed bulbs for planting a similar extent, viz. 124 square feet would be -/45, while the ½ oz. of seed cost less than 10 cents, so that where large areas are planted, as at Pt. Pedro, there should be a great saving by using seed.

The seed was put in nursery on October 10th, transplanted November 15th, and the crop lifted on February 22nd. From the results obtained it ought to be possible to secure a yield of over 100 cwt. per acre, using, say, 5 lb. of seeds costing Rs. 15/-. [In MOLLISON's tests the yield per acre was 35.000 lb. or 300 cwt : he recommends 15 lb. of seed for a nursery for planting out an acre.]

In this connection the following notes (prepared by MR. S. CHELLIAH) on Onion cultivation as carried on in the Jaffna Peninsula is interesting as indicating what scope there is for improving the methods now in vogue, especially in saving cost of seed and improving yield :—

Onions are largely cultivated in Vadamaradchi and Valigamam West, but each cultivator's plot is seldom more than about ⅛ of an acre. Onions imported from India, owing to their mild flavour, are not so popular as the local product which finds a market outside the peninsula, especially in the Eastern Province.

Soil.—Loose soils are considered the best for onions, but they are also cultivated in paddy lands as a rotation crop during the dry months. The dark loam in the Point Pedro District is specially favoured and onion-growing is fairly extensive there. *Manures.*—Green leaf and sheep manure are chiefly used. The soil is first dug with the mamotty to a depth of about a foot and a half. Sheep are then penned till an

acre receives the manure of about 6,000 sheep costing about Rs. 60. The soil is then slightly turned over and leaf manure is applied. *Adhatoda Vasica* is the most popular kind of leaf manure and is obtained from the Western districts of the peninsula at a cost of Rs. 25/- per cart-load. Four cart-loads are considered sufficient for an acre. When this is not available ordinary leaves are used and cost much less. Ashes are considered to have a bad effect. *Season.*—Planting is done three times in the year, viz., in May, July and December. The crop is reckoned to be ready in about 70 days. The July crop fetches a higher price than the others. *Planting.*—The manured land is laid out in small plots of about a yard square, surrounded by ridges to retain water. For the July and May planting well water is led into the plots by channels. Selected bulbs of a previous crop (which should be at least six months old) are topped and tailed and planted 2 inches apart after the water in the plots has soaked in. If the seed bulbs are less than six months old it is believed that ordinary roots will be developed at the expense of bulbs. The beds are irrigated once in four days. The December planting differs from the others in that no water is led into the plots previous to the planting, the bulbs are planted 3 inches apart, the first irrigation is done on the 13th day after planting, the second after an interval of 8 days, the third after another interval of 6 days and subsequently every fourth day. The quantity of seed-bulbs used per acre is about 19 cwt. costing about Rs. 150/- Propagation by bulbs is the only means known to the Jaffna cultivators. Propagation by seeds obtained from India has been demonstrated by me, and it has been proved that this is a much less costly way of growing the crop.

Harvest. The average yield per acre is about 4720 lb. which at, say, 8 cts. per lb. gives a gross return of Rs. 377/60.—C. A. S. PROGRESS REPORT.

THE CEYLON AGRICULTURAL SOCIETY.

Among other subjects reproduced elsewhere the 67th Progress Report of the CEYLON AGRICULTURAL SOCIETY contains the following :—

GARDENS.

The following is a list of trees established and beginning to bear in the *Bandaragama Garden* :—Orange 172, Mandarin 17, Jambu 6, Guava 6, Lime 10, Soursop 29, Rambutan 4, Sapodilla 1, Mangosteen 5, Durian 1, Kola 3, Avacado Pear 3, Billing 1, Star Apple 2, Rose Apple 7, Mango 10, Jak 2, Bullock's heart 3, Wood Apple 2, Uguressa 3, Citron 2, Masan 5, Lovi-lovi 1, Pumelo 7, Slime Apple 1, China Guava 1, Coco-plum 1.

Further additions will be made to the collection during the May rains.

The cultivation of *Tephrosia candida* between the lines has had a marked effect upon the trees, and a separate plot is about to be laid under this green manure crop for cutting and mulching. The plant not having matured seed, a fresh supply is being procured. For those who are wanting seed of Tephrosia candida or (as it is more commonly called) "Boga medelloa,"

it may be stated that large quantities are locally available at 75 cents per lb. or Rs. 80/- per cwt. delivered at Bandarawella Railway Station.

One section of the orchard has been dug over and cleared of grass, and plants have decidedly benefited by this treatment.

Mr. L. A. D. Silva, A.I., was in charge of this garden for the past few months.

Work at the *Weragoda Garden* progresses satisfactorily, and a number of grafted plants are now in fruit.

The Secretary paid a visit to the Maggona Reformatory, where the garden is registered for the grant payable by the Educational Department, and was greatly pleased with what he saw. This institution is doing excellent work in training the boys sent here in practical agriculture and horticulture.

Reports on work in connection with the Tobacco trial ground at Jaffna are of a very satisfactory nature, and it is likely, with the experience gained during the past season, that trial plots will next season be established in other tobacco growing areas. In this way it is hoped to gain some idea of what new varieties are likely to prove suitable to each district with a view to replacing the inferior local "jat" of tobacco.

The complaints received from various quarters of the difficulty experienced in disposing of native leaf is an indication that the supply is more than sufficient to meet the local and Indian demand, and that if the tobacco industry is to be placed on a proper footing the produce must compete in the open market, to which end the adoption of improved types of leaf and better methods of preparation is essential.

A revised tobacco leaflet by Mr. B. Scherffius, Tobacco Expert, Jaffna, will be issued shortly.

A NEW GREEN MANURE.

Last July Mr. K. B. Beddewela drew attention to the manurial value of a plant locally known as "Bodi" found in Bodiwella, Udahewaheta, where the fertility of fields upon which the plant is found growing spontaneously is very marked. Specimens of plants were procured with the help of the Assistant Government Agent, Nuwara Eliya, for identification and chemical examination.

It was found to be *Psoralea corylifolia* (Leguminosæ) and was duly examined by the Government Agricultural Chemist, who, in forwarding a detailed analysis, reported as follows :—"It will be seen from the figures that the plant contains a fair proportion of nitrogen (2·56 %) in the sun-dried state. The best green manures contain about 3 % nitrogen. The ash is present in the plant in large proportion (9·28 %), but it will be seen from the ash analysis that the sand and insoluble matter amount to over 25 % of the total ash, showing that a good deal of soil adhered to the plant after washing : so that to arrive at the true percentage of ash in the plant the

percentage given ought to be reduced by about 25 per cent., and the constituents in the ash analysis ought to be increased by that amount. The plant is a greedy feeder of potash and lime, and would be useful in drawing supplies of these ingredients from the subsoil and giving them to the surface soil when the plant is mulched as a green manure."

INTRODUCTIONS.

7 varieties of the following Philippine rice were obtained through the kind offices of the Director of Agriculture, Manila, and are being tried in Kandy and Ratnapura, viz. Macan 179, Inasimang 169, Mulanay 143, Piniling Daniel 171, Pauni 144, Macan Pina 143, Senora 11,145. The figures indicate the "ages" of the respective varieties.

Seed of a variety of Melon (*Cucumis Dudain*) was received from the Ministry of Agriculture, Egypt. This is a superior variety, of fine flavour, and takes from 6 to 7 months to crop. The seed was widely distributed in March and is reported to have germinated well.

Seed of the Mankatan Melon from Cape Colony previously distributed proved a failure, but it is hoped to secure another fresher lot.

A quantity of *Carum copticum* (Ajowan) seed was obtained from India and distributed to the following centres: Kurunegala, Kegalle, Jaffna, Kandy, Galle, Gampola, Udispattu, Mediwake, Badulla, and Ratnapura. The seed of this plant is one of the chief sources of Thymol.

Senna seed (*Cassia angustifolia*) from South India was distributed early in April. Senna is a mild laxative and blood purifier, and there is no reason why it should not be grown to meet the existing local demand.

Still another variety of melon has come from Egypt. This is a round yellow kind locally known as "Quawoon." Members wanting seed should apply to the Secretary without delay.

LAC CULTIVATION.

Lac raised last season on MR. BEDDEWELA'S Maligatenne Estate was used for inoculation at the Government Stock Garden, Jaffna (2 places) and Kandy (3 places). The lac is doing well in Colombo and Kandy. It is hoped to secure a crop of brood from these places in June—July, and extend the cultivation to Tangalle, Anuradhapura, Kurunegala and Kegalle. At the first mentioned place efforts are being made to interest the lac-workers in the neighbourhood, with a view to their raising their own supplies of lac.

MR. KARUNANAYAKE, Agricultural Instructor, Hambantota district, reports that the lacquer work industry is on the wane owing to the difficulty experienced in securing local supplies of lac which have hitherto been drawn chiefly from wild *Croton lacciferus* tree. It is expected that the Society's efforts will result in giving a fillip to the industry.

AGRICULTURAL EDUCATION.

The four Government Agricultural Scholars sent to Poona College returned to the Island at the end of March after their 3 years course. They will serve a term at the Experiment Station, Peradeniya, and the Government Training College before entering upon their duties in connection with the proposed School of Agriculture.

At the request of REVD. J. PAUL GIBSON, MR. MOLEGODE conducted a class in Agriculture at the C.M.S. Training Colony, Peradeniya, on Friday afternoons during February and March.

The four teachers who were sent out from Burma for training in the methods of School Gardening and inspection of Gardens completed their course last March, and left the Island at the end of that month. During their period of training they were given every facility for attaining the object for which they were sent.

MISCELLANEOUS.

A sample of *Groundnut Cake* for manuring purposes was received from MESSRS. VENKATRAM & Co., of 25, Periyana Maisty Street, Madras, who quote Rs. 13/- per candy of 500 lb. delivery ex godown. They guarantee quality and regular supplies from their mills, which are said to be run directly under the supervision of the Director of Industries, Madras.

The Government Agricultural Chemist, in reporting on a sample of *Coconut Vinegar* manufactured in Kalutara, offered at Re. 1/25 per gallon, gives the total acid as Acetic Acid at 4 per cent, and states that though fit for human consumption he does not consider the vinegar suitable for the coagulating of Hevea latex, as "ferments are still present and will be found in the prepared rubber." He adds that distilled acid is on quite a different footing as it has undergone sterilisation.

The Director, Imperial Institute, writing on the subject of *Cassava Chips*, for which a large demand was reported some time ago, states that the price offered is about £ 6 per ton, i.e., 4 to 5 cents per lb. In Jaffna, where dried cassava is found in the market, the price per lb. varies from 5 to 8 cents according to season.

Gigantic specimens of *Plectranthus tuberosus*, known as the "County potato," (with which the "fra-fra" potato received last year from the Gold Coast appears to be almost identical) were received from the Gunnepana School Garden and were exhibited at the meeting of the Committee of Experiments held in March. The tubers were four times as large as those usually exposed for sale in the bazaars and were of good flavour. Excellent clusters of the *Jerusalem Artichoke* raised at the Tenne School garden were also exhibited on the same occasion.

Early in May MR. BEDDEWELA forwarded to the Secretary 25 fruits from his *Grape Fruit* tree, of which a photograph was taken before the plucking of the crop.

MR. MAPPANAR, Acting Agricultural Instructor, Northern Province, forwarded to the office a very fine sample of *arrowroot flour* prepared by him from tubers raised at the Society's Garden in Jaffna.

A model of a simple *coir-yarn machine* has been sent to the Industrial School, Kalmunai, where its working will be demonstrated by the Agricultural Instructor with the object, if possible, of introducing coir-yarn manufacture into the district where no such industry at present exists.

INTERESTING NOTES ON SOME TROPICAL CROPS.

DEAN COPELAND of the Philippines has written a comprehensive report on his visit to Java, published in the PHILIPPINE AGRICULTURIST AND FORESTER for April last, from which we quote the remarks about such low country crops as we are interested in.

Rice has of course received the foremost attention. Experiments have been made within the last few years on something more than a thousand varieties of rice. These have aimed to answer almost every question of economic importance : the identification of varieties and establishment of the

characterisation of each as a basis of recommending the most productive or otherwise most desirable varieties for different localities, different seasons, and different specific uses. The general types of rice in Java and the Philippines are identical. Thus, we see in Java bearded and beardless rice, glutinous and non-glutinous varieties, grain of the same range of form and colour which are familiar in the Philippines, and varieties said to range over the same length of growing season. The selection work at Tjiekeumeuh follows strictly what has come to be known as the Svalof system, because first put into well-known practice at the Swedish Experiment Station of that name. All selection is along pure lines, the individual plants being the basis. It has been evident from the start in Java, as here, that the named local varieties are themselves mixtures so diversified that they are not in their natural condition fit subjects for selection. Accordingly, single plants have been selected from the local plots of the various promising varieties, and these plants are the parents of the strains which have been developed and distributed. This system is exactly the same inaugurated here in the thesis work of MR. MARCELO CRISOSTOMO. Work of this kind is necessarily slow because, beginning with a single plant, the strain must be built up until plots can be tested before conclusions are justified or seed can be distributed.

Upland rice is of far less relative importance in Java than in the Philippines, the area being very much less than that devoted to paddies. In some parts of Java, including those which I visited, rice can be raised at all seasons, and a very large part of the country is at all times in rice. In this region, rice in every stage can be seen at one time and from one place. The seed beds will be found in one field, while in neighbouring fields the ground is being worked, or the plants have just been set out or will be half grown, and in others in the neighbourhood, the harvest is already taking place.

In Java, as in Japan, the production of rice is less than the demand. This has been true, I believe, during every year for something more than a decade, and has resulted inevitably from the rapid increase in population of the island. But from Java as from Japan, there is still a very heavy exportation of rice. This exportation is of superior rice which brings the world's best price. While this exportation takes place, there is a more extensive importation of materially cheaper rice from Indo-China and Burma. The higher price received for the rice exported goes a good way toward paying for the larger quantity required for local consumption. This economic advantage, resulting from the production of a very superior quality, is a fruit of the activity of the Government in constantly distributing seed of rice of the best strains, and so raising the general level of the quality of all Javanese rice.

Manioc.—The Dutch Indian Government has directly imported a considerable number of varieties of this plant from Brazil, besides collecting what were available in the Orient. Besides cultivating these various pure strains, working according to their usual plan with the individual plant as the basis of selection, they have also raised a large number of seedling strains, and so increased the number of strains and the range of variation. On the whole, the best results up to the present time have been obtained with some of the strains imported from Brazil.

There are a few spots in Java where, for local reasons, manioc is the principal food staple. This may be because the climate is very dry or because, in spite of their having reasonable rainfall, the soil is so porous that irrigation is not practicable. Any condition which makes rice growing impracticable brings manioc to the front. The work on trial plots at Tjikeumeuh has shown yields about the same as of the best which we have obtained at Los Baños. It is evident from these results that the same ability which will produce 80 to 100 piculs of food in the form of rice on one hectare of land will produce fully 250 piculs of food in cassava on the same area, and that the production of the cassava is with materially less expenditure of labour.

It follows clearly that cassava can support a much denser population than rice, not only because it produces more food to the unit of area, but because at the same time it leaves more labour free for other employment. Against this, there is in Java, as in the Philippines, a distaste for cassava as a staple food, and a popular feeling that in large quantities it is not healthy and strength producing. As to its palatability, the trouble is unquestionably with the method of preparation. There is no disposition anywhere to regard tapioca with disfavour, but the cassava is usually eaten in the tubers instead of after the preparation which would make it really acceptable. As to its food value, it is more digestible than rice, but not as complete a ration. It therefore needs to be combined with other foods, and its excess in production over rice is so great that the production of the necessary other food as a side issue should be a very simple matter. It is gaining rapidly in respect throughout Java as a famine food which it is well to have always available in case of emergency. The Government of the Indies is pushing this use of it by encouraging the planting in every community of at least a small area.

Aside from its local use as a food, cassava is of considerable and increasing industrial importance as an article of export. Even in country as wet as that I visited, I saw very numerous small fields of cassava between Batavia and Buitenzorg, which, altogether, would amount to a very considerable area in this crop. Seeing these small fields, I imagined at first that they were for local food, and was much surprised at the area devoted to it. It was afterwards explained, however, that while some of this crop was sure to be used as food, and an appreciable part of it might be so used if other crops failed, it was expected that the larger part of it would be sold to factories for the manufacture of cassava flour or starch. In the drier part of Java the production of cassava flour is becoming a very important industry. I got statistics for instance, with regard to one plantation, run by a company with a capital of Fl. 2,000,000, which paid dividends on its crop of 1913 amounting to Fl. 1,350,000. The cost of production per picul is about Fl. 3, and the normal price is about Fl. 6 per picul. At the outbreak of the European war, the price fell for a few days to Fl. 1·35. As in the case of the slump in copra in the Philippines at the same time, the effect was that there was no market at all. As in the case of copra, the slump was temporary, and the price has for some time been normal. This company uses 3,000 bouws (a bouw is seven-tenths of one hectare) of land. The crop is regarded as a very sure one, and the price of Fl. 6 as a normal one. Apparently, one may conclude that the business is handled on a very wide margin of profit. It may be noted in passing that the 3,000 bouws of land does not belong to the corporation, but it is in the hands of the Javanese natives, who rent it on very short leases to the company. The practice is therefore not to use the same fields for this crop for a succession of years.

Sweet-potatoes.—Selection work on sweet-potato at Tjikeumeuh has been carried on with all available varieties, local and imported, and also by the production of seed ; and in this case, some of the seedlings, from varieties which were themselves regarded as superior, produce yields of something like twice as much as the parent strains. When these results are obtained with seedlings, the individual plants are propagated in the usual vegetative manner until a stage is reached where distribution becomes possible. With the sweet-potato, this stage is reached fairly promptly, so that a successful experiment of this kind is not long in resulting in materially large yields by the native Javanese, without the slightest additional expenditure of money or effort. Including the seedlings, the experiments at Tjikeumeuh have included plot work with something more than 600 separate strains.

Ground-nut.—This is the most important legume in Java. The use of legumes for the enrichment of the soil is practised in Java on an exceedingly wide scale. In fact, outside of the regions where rice can be cultivated

throughout the year, the use of legumes and the appreciation of their soil-enriching value can be said to have become almost universal. It has already been noted that they are used throughout the Government forestry plantations. They are also used universally on sugar lands in alternation with sugar, and on the tea and coffee plantations planted with the regular crop, but kept close to the soil and continually cut down and worked in. The peanut is not merely valuable for this reason, but is apparently the foremost leguminous food of the Javanese, and is in very extensive use for the production of oil.

Phaseolus max.—Second in importance of Javanese legumes is the mongo. As in parts of Pangasinan, so in places in Java, this is regularly raised in alternation with rice. It is eaten in Java, as here, usually in the form of the very young seedling. In Java it is regarded as a cure for beri-beri, and is said to be consumed not so much because it is liked, as for its value as a preventive for this disease.

Regarding the relation between rice and beri-beri, the disposition of the Javanese and the Filipino is the same—that is, to use polished rice, and to regard unpolished rice as not merely inferior but as somewhat degrading. The Government in the Dutch Indies issues unpolished rice in its prisons and to its troops, but has not made such a propaganda as has the Philippine Government to secure the extension of the use of the unpolished grain. The reason for this is, perhaps, that it has not as practicable a method, as is furnished here by the public school, for carrying on this kind of a campaign.

[A hectare = approximately 2½ acres. The use of leguminous seeds for food after germination as "very young seedlings" is common in India.]

FORAGE CROPS FOR SEMI-ARID REGIONS.

H. D. SCUDDER.

All the farmers who had grown alfalfa on the dry lands of Oregon did it to cut for hay, and sowed it broadcast, but they did not in all cases obtain favourable results. The writer advised sowing it in rows, and considering the promising results obtained, and the fact that where moisture is scarce plants, while developing less in stalk and leaf, produce an abundant crop of seed, the planting of alfalfa in rows for seed production was undertaken on the Experiment Stations and demonstration farms of the Columbia Basin and Central Oregon, as well as with co-operating farmers. The object aimed at was to secure a strain of alfalfa that would meet the following requirements; (1) produce a seed crop quickly and mature it before the autumn frosts; (2) be sufficiently hardy at the highest altitudes (from 2,000 to 4,000 feet) to withstand the cold with practically no snow cover for protection; (3) be a vigorous rooter and resistant to drought; (4) produce an abundant crop of seed; (5) produce a reasonably good growth and quality of forage or hay.

ALFALFA FOR PRODUCTION OF SEED.

Seed of the most promising varieties was obtained from different parts of the world and trials with them were started some years ago at the Corvallis Station. Both there and throughout the Columbia Basin and Central Oregon the best results from every point of view were obtained with the Baltic strain of common alfalfa.

This strain properly cultivated will produce from 100 to 300 lb. of seed per acre. Moreover, this seed grown in the humid regions at lower elevations, such as in Western Oregon, will produce a far superior crop than seed

grown in warmer climates and lower altitudes, such as in California, Kansas and Utah, and consequently commands a higher price. Where this strain of seed cannot be secured the Grimm is believed to be the next best.

The methods recommended by the writer of cultivation on the dry lands are as follows :—

After the grain harvest, the stubble is double disked ; then ploughed deeply in the autumn. In spring, as early as possible, the ground is disked thoroughly and then kept well cultivated, mulched and clean of weeds until seeding time, which is about the middle of April in the Columbia Basin and about May 15th in Central Oregon.

If the previous crop was a hoed one of field peas in rows, the ground need not be ploughed, but may be thoroughly disked in the autumn and in the spring. Where the ground is unusually foul with weeds or where the subsoil moisture supply is greatly reduced, the dry lands should be summer fallowed prior to seeding alfalfa.

On the dry-farming lands alfalfa should be sown in single drill rows 35 inches apart and just as thinly in the row as possible. The ordinary grain drill may be used with the extra parts called "alfalfa reducing plates" or wire riddles, so as to reduce the amount of seed and the seed-bed in good condition ; even a pound and a half will give an ample stand. One plant about every 8 inches in the row is about what is desired in the 10-inch rainfall belt. The seed should be put in not deeper than $1\frac{1}{2}$ in. and then rolled or pressed. In all cases the rows should be seeded at right angles to the direction of the prevailing winds. After seeding, the ground may be harrowed as often as is necessary to maintain a good mulch and keep down the weeds. When the plants are 2 to 3 inches high they should be cross-harrowed severely or even disked crosswise until the stand is reduced to one plant every 12 to 18 inches in the row. This practice is indispensable to give the plants ample room on all sides to produce seeds, and it cannot be successfully carried out when the crop is 3 or 4 months old, because the roots by that time are so thick and tough that a disk or plough would not cut them. It is the writer's belief that the thickness of the stand on the Eastern Oregon dry lands has more to do with pollination than any other factor. In summer when the plants are in full bloom, evaporation is intense and the crowded plants become more or less flaccid of tissue, and this seems to have an effect upon the delicate blossom and its pollinizing mechanism. The writer tried to favour pollination by "tripping" the blossoms by running crosswise over the rows a light wooden roller, but with no great success, which he explained by the fact that the blossoms are in all stages of development at any given time and only a few of them are just at the point for successful "tripping."

The writer does not believe that planting the seed in hills 3 feet or more apart each way would be advisable. It would be more expensive and difficult, and the effect upon fertility would probably be less and harvesting would be harder.

Ordinarily three or four harrowings, followed by two or three cultivations with a corn cultivator, will be sufficient to maintain a mulch and destroy the weeds. The alfalfa should be clipped whenever weeds outgrow it, or begin to ripen seed, or if mildew or other disease appears (hitherto no sort of pest has ever been reported on alfalfa in Eastern Oregon). It should also be clipped whenever it begins to blossom, as the formation of seed during the first year would weaken the development of the plant. The plant should be allowed to make a growth of 5 to 6 inches before the winter. The occurrence of dodder must be prevented by the usual means.

During the second year the crop should be disked once or twice crosswise early in the spring. Later it may be cultivated with a harrow, and still later with a shovel cultivator.

In regions where the rainfall is scanty and the growing season short the seed crop should be made from the first cutting. Under more favourable conditions a clipping of the crop should be made when it is 6 to 8 inches high and the second cut left for seed, when all the plants will blossom at the time and mature the seed more uniformly.

ALFALFA FOR HAY.

Where it is desired to grow alfalfa as a hay crop, it may be seeded more thickly in the row, 3 lb. per acre being ample. No thinning should be done. In districts where the rainfall is 18 inches or more, the rows may be made at 28 or even 21 inches apart, or double-drill rows 28 inches apart may be sown. In other respects the same methods of cultivation should be followed as for seed production.

For pasturing, pigs prefer the Baltic alfalfa to the common variety, which they do not touch before the former is pastured down to the stubs. The writer recommends dividing the field by means of movable fencing. He advises also ploughing up the crop, in the dry-farming lands, at least every fifth year and putting the land under other crops.—MONTHLY BULLETIN.

A POSSIBLE SOURCE OF MOTOR SPIRIT.

MR. ALFRED CHATTERTON, of the Madras Department of Industries, expresses the opinion that no better substitute for petrol could be found than ethyl alcohol manufactured from the juice of the sugar cane or from molasses, provided of course the price of petrol rose, as it tends to do, till this form of alcohol could compete with it on equal terms. He proposes to denature ethyl alcohol by the addition of methyl alcohol, a product of wood distillation, and considers the manufacture of alcohol from sugar cane or molasses a possible industry in South India, many parts of which have the climate and water supply for growing heavy crops as well as the necessary labour for the production of sugar as cheaply as in other parts of the world.

WHAT RESEARCH MEANS.

E. W. ALLEN.

A few years ago a speaker at a meeting of the Association of American Agricultural Colleges and Experiment Stations declared that the great need of the experiment stations was for thoughtful reflection and consideration—the opportunity for deliberation and study. The need is as great to-day as it was then, possibly more so. It is one of the handicaps which remains to be corrected.

While there has been considerable progress toward a differentiation of duties and of personnel in our colleges and stations, the protection of the investigator from distractions and interruptions, and from demands of many kinds outside his special field, is still quite incomplete. The effects of it are a heavy burden on our research activity, a load it seems hard to shake off. The result is reflected in the nature of the work, the extent of its constructive character, the degree of its completeness as finality as far as it goes. The growth of the agricultural work and of appropriations for it has not always meant a correspondingly larger opportunity for substantial investigation. It has been so rapid and many-sided that concentration in station work has been difficult and often impossible for men of broad interests and sympathies.

If research is, as has often been said, an attitude of mind, it is an attitude of sound inquiry, of thoughtful consideration, of concentration of all the powers for the time being upon the subject in hand. It is an intellectual product, in which the things actually done are a resultant of the reasoning that lies back of the doing. It is a searching process, directed by reasoning from a well founded hypothesis, and carried forward by the accumulation of facts and their correlation in a manner to establish a truth. Hence, it calls for attentive study of all stages, and applies to all kinds of inquiry. The grade will affect the intensity, but the essentials must be present if the effort is to be productive. Investigation or experiment or any form of inquiry which is not accompanied by thoughtful consideration is little more than routine, and can establish little.

As a speaker at one of our station meetings a few years ago said: "To get an intelligible and decisive answer of nature requires more than zeal or hard work. It needs hard thought and wide knowledge in framing the question. It needs what LOVELL has called the 'unsullied temper of a well taught mind.'" To meet this need fragments of time, periods subject to frequent interruption, intervals when confusion and commotion prevent concentration, are far from being sufficient. And because they are not sufficient, and because conditions do not afford more opportunity for seclusion or it is not insisted upon, results are sometimes accumulated without being studied, and finally published without proper digestion, in the mistaken idea that they are a record of investigation.

The taking of records is not all of investigation but a means to it, an essential step in it. The records may often be made by a careful assistant who faithfully follows directions, but if anything vital comes of them it will be through a critical study which weighs cause and effect, correlates the new data with reference to an idea or hypothesis, and derives from them the facts they prove or a new point of departure. This comes from close work, a sinking of oneself into the subject, a thorough mastery of the facts, and their logical interpretation. It requires time and concentration.—EXPERIMENT STATION RECORD.

RELIEF TO THE BELGIANS.

MR. W. A. M. GOODE, Honorary Secretary of the National Committee for Relief in Belgium, has furnished us with the following appeal signed, as it will be noticed, by the LORD MAYOR OF LONDON (Chairman), the ARCHBISHOP OF CANTERBURY and others, which we trust would appeal to all our readers throughout the Empire :—

TO THE EDITOR,

SIR,

On behalf of seven million Belgians, who have dared to stay in their native land, we appeal to our fellow-countrymen throughout the British Empire. A great emergency has arisen ; an emergency which involves our national honour. We are well aware of the magnificent response already made by generous and patriotic individuals to appeals for funds during the present war ; yet, under the circumstances, we do not hesitate to say that we must make further and even greater sacrifices to meet the emergency of saving the people now left in Belgium from the horrors of slow starvation. No victory could be lastingly glorious if it involved the decimation by famine of a small nation that deliberately sacrificed itself rather than sacrifice its honour.

From the day when the people in Belgium laid down their land and their lives for the sake of their country's independence and the honourable fulfilment of its undertaking to maintain a perpetual neutrality, the German Army of occupation has refused to feed them. They have been kept alive only by the merciful and effective interposition of a neutral Commission for Relief, formed under the auspices of the American and Spanish diplomatic representatives in Brussels and London. That Commission, of which MR. HERBERT HOOVER is Chairman, has worked miracles by arranging for the importation into Belgium,

in the face of unparalleled difficulties, of food supplies valued at over £10,000,000. The philanthropy, rendered necessary by the large number of destitute who cannot pay for their food, has been generously aided by the United States and the British Dominions. No appeal has been made by MR. HOOVER's Commission in the United Kingdom because, as neutrals, they quite properly considered this was not within their province. MR. HOOVER and MR. FRANCQUI, Chairman of the Commission in Brussels, now write :—

"Unless we get more assistance hundreds of thousands of the seven million people still in Belgium will actually starve. At least a million and a half Belgians are now entirely destitute. With the rapid exhaustion of the meat and vegetable supplies there will probably be, before harvest time, 2,500,000 in Belgium who must be fed and clothed solely by charity. The remaining 4,500,000 will get their pitiful daily allowance of bread through the Commission and will pay for it. Will you help us to keep the destitute alive ?"

To this question there can only be one answer. Having satisfied themselves that His Majesty's Government saw no objection, the undersigned have formed the National Committee for Relief in Belgium, in the confident belief that the people of the British Empire will not allow the bulk of the Belgian nation to die for lack of bread.

In providing a national channel for every part of the British Empire through which benevolence to meet this emergency shall directly and safely reach the Belgians in Belgium, it is also intended to consolidate the existing philanthropic efforts in this direction.

As it is obviously impossible for any British subject to enter the occupied part of Belgium, the representatives of the neutral Commission will distribute the relief purchased from the National Committee's funds. MR. WHITLOCK, the American Minister in Brussels, on March 29th wrote as follows :—

"I am glad to be able to say that there is not a single instance in which a pound of food sent under our guarantee has been touched by the German authorities."

In conjunction with the Belgian "Comité de Secours" and under the supervision of neutral Americans actually in Belgium, a system of distribution has been organised so perfectly as to make it almost physically impossible for a German soldier to touch one loaf of Belgian bread. All the neutral authorities on the spot are convinced that if the supplies of food to Belgium are discontinued the Germans will act up to their declaration that they will not, or cannot, save the seven million people from starvation to death.

To keep body and soul together in the 1,500,000 who are now utterly destitute £500,000 a month is required. The desolating hand of war has throttled Belgium's industries and pauperised almost a third of her population. In Liége 30,000 women, old men, children and cripples daily line up to get their half-pound of bread and their pint of soup. In Malines, 25,000 out of 40,000 are entirely destitute; in Brussels nearly 250,000 Belgians wait every day for their bread of tears. Babies and children are barely being kept alive for want of milk. So it is throughout all the country where those who stayed and bravely faced the invader are now dependent upon the mercy of the world. And if that mercy is denied, the amazing self-restraint of these seven million people will collapse. Under the impelling anguish of hunger they may be tempted to strike desperately, but with tragic unarmed futility, and will be shot down, like so many wild creatures, in streets that were lost by sacrifice as noble as the world has ever known.

Only organised effort on an unprecedented scale will avert this tragedy. In caring for the 200,000 Belgian refugees now in this country, we are apt to forget that the great bulk of the Belgian nation—at least seven millions of them—are living under conditions of such misery as can scarcely be conceived by a people who, like ourselves, have been spared the horrors of invasion.

Faced with a situation from which there is no immediate escape, deprived of their freedom, the people of desolated Belgium only asks from us enough bread to keep themselves alive. Shall it ever be said that we denied them this ?

Food cannot be exported from this country to Belgium, but the donation so urgently needed to buy it should be sent to the Hon. Treasurer, MR. A. SHIRLEY BENN, M.P., Trafalgar Buildings, Trafalgar Square, London, W. C. The working expenses of the National Committee have all been generously provided for, and every penny or every pound received by the Treasurer will, without any deduction whatever, reach the long-suffering Belgians in the form of food.

CHARLES JOHNSTON, Lord Mayor of London, Chairman.

RANDALL CANTAUR.
FRANCIS CARDINAL BOURNE.
THOMAS NICOL,
Moderator, Church of Scotland.
JOS. COMPTON-RICKETT,
President, Free Church Council.
J. H. HERTZ,
Chief Rabbi.
W. A. M. GOODE,
Hon. Secretary.

NORFOLK.
LANSDOWNE.
ROSEBERY.
BRYCE.
ARTHUR HENDERSON.
JOHN E. REDMOND.
A. SHIRLEY BENN,
Hon. Treasurer.

The U. S. A. Department of Agriculture recommends spraying with flour paste against red-spider. A pound of flour is boiled with a gallon of water, and 8 gallons of this stock paste diluted to 100 gallons. The paste may be combined with lime-sulphur, 4 gallons of stock paste to 96 of lime-sulphur.

A statement showing the exports of Nitrate of Potash from Calcutta last year gives the total as 13,842 tons. The largest amount (6354) goes to the United Kingdom, the second largest (2710) to China and Japan, the third (2060) to Colombo. The demand for nitrate has increased greatly since the war, but the supply is said to be unlimited.

Pure crystalline thymol from Ajowan seed is now being produced in Calcutta by the Bengal Chemical and Pharmaceutical Works, Ltd. The first to make this chemical is a native of India, MR. CHATTOPADHYAY, a chemist working in the laboratory of the firm.

Dried and ground sardines were fed at the rate of $\frac{3}{4}$ lb. per head per day to six heifers for six months, six other heifers being used as controls. No ill effects followed from the addition of the fish to a mixed ration, and after a little time no trouble was experienced in getting the animals to eat it. So far as its fattening value was concerned fish did not compare favourably with ground nut. As a result it was not recommended for inland localities from a financial point of view, though it was thought that a considerable saving might be effected by its use on the coast of India.—JOURN. OF THE BD. OF AGRIC.

The cultivation of a hardy variety of the sweet potato as a cover crop is an effectual way of eradicating the weed commonly know as Nut-grass, which is really a sedge (*Cyperus rotundus*). Dry land (hill) paddy is sometimes grown as a weed eradicator.

In manuring fruits as bananas, pine-apples, etc., the QUEENSLAND AGRICULTURAL JOURNAL recommends the use of basic slag instead of superphosphate or other so-called acid phosphate, which becomes rapidly altered into insoluble phosphate. Bone meal may be effectively used in alternate years instead of basic slag. Nitrogen may be applied as blood manure mixed with other manures, or in the form of nitrolim as a top dressing. An application of limestone screenings at the rate of 1 or 2 tons per acre every third year is very beneficial, particularly now that potash is getting scarce. Limestone is not a substit te for a potash manure but will liberate potash in the soil.